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The telephonic " dispatching system "
on the Belgian State Railways, ⁽¹⁾

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CHAPTER I.

Conditions on the Belgian Railway System before the war.

Before the war the traffic on the Belgian State Railways was heavy and increasing rapidly from year to year.

For the period 1903-1913 the number of passengers carried per annum increased from 131 millions to 202 millions (fig. 1) or an increase of 54 % in ten years. The average annual increase consequently amounted to 5.4 %.

During the same period the volume of goods increased from 44 million metric tons in 1903 to 66 million metric tons in 1913 (fig. 2) which corresponds to an increase of 50 % in ten years and corresponds to a mean annual increase of 5 %.

On these respective bases of 5.4 % and 5 % it will be seen that the traffic would have doubled in twenty years.

Examination of figure 1 shows that the hollow in the curve for passenger traffic due to the economic crisis of 1908 was soon filled by the still more rapid increase of the following years to the point at which A, B and C can be joined by a straight line.

The same remark applies practically to the goods traffic (fig. 2). It appears that in the years of crisis the unsatisfied requirements accumulate and at a later date cause commercial exchanges of greater number thus restoring the law of normal increase. One is tempted to conclude from this that the war years also will only constitute a gap and it would seem wise to take account of this when investigating improvements to be made in the Belgian Railway System.

Apart from the doubling of the tracks, the construction of new lines, the erection

of subsidiary stations, etc., it was necessary, in view of the increase of traffic, either to increase the number of trains and their mileage, or to increase their useful load.

As shown in figures 3 and 4 the useful load of the goods and passenger trains was raised to some extent. That of the goods trains was raised from 146.8 useful tons in 1907 to 175.5 useful tons in 1912, or a total increase of 19.5 % in five years or a mean of 4 % per annum. This result was mainly obtained by increasing the tonnage of the wagons and by increasing the power of the locomotives; this was necessary because the length of the trains is limited by various technical considerations (length of sidings, visibility of signals to the employees at the rear of the train, distance between distant signals and home signals, danger of broken couplings, etc.).

The increased use of passenger trains was slower because it was complicated by the desire for increased comfort; the number of passengers per train increased from 103 in 1907 to 110.5 in 1912 or a total increase of 7.3 % for the five years or 1.4 % per annum.

As the weight of the trains could only be increased to a small extent, it was only possible to meet the increase of traffic by increasing the number of trains and increasing the distance run by them. Table 1 shows what happened during the period 1903 to 1913; the particulars are given per day: lower numbers are thus obtained which show the relative value better.

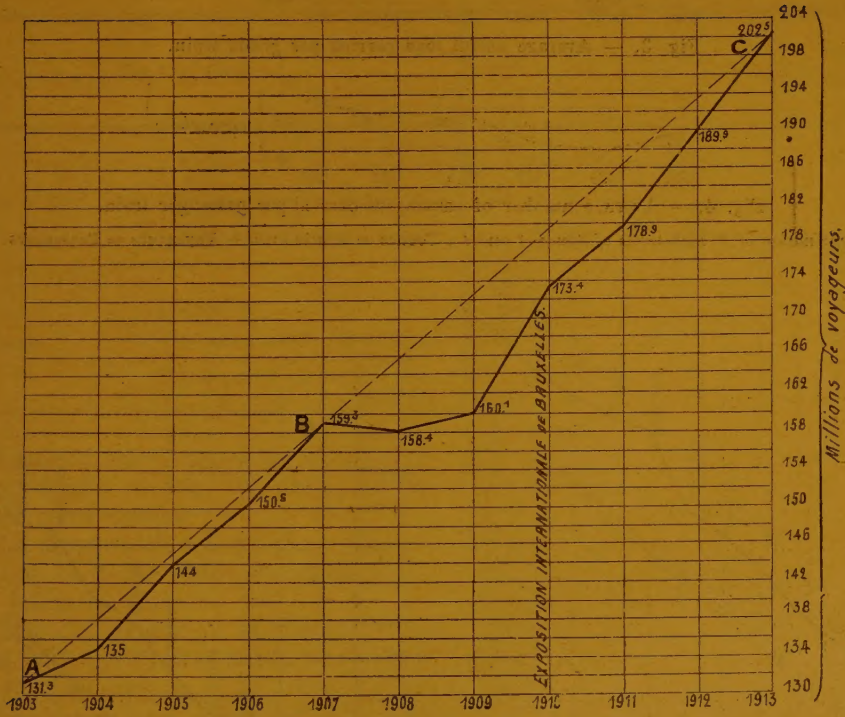


Fig. 1. — Number of passengers carried in millions.

Explanation of French terms : Exposition internationale de Bruxelles = Brussels International Exhibition. — Millions de voyageurs = Millions of passengers.

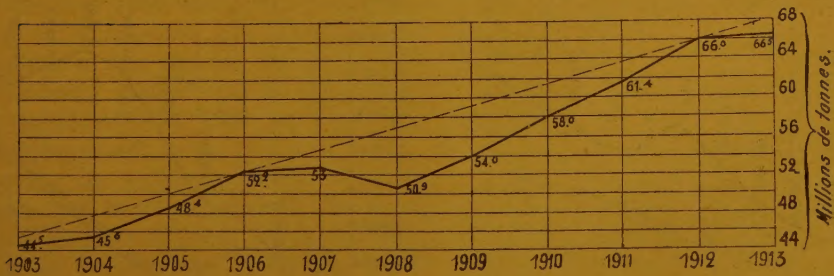


Fig. 2. — Number of gross metric tons of goods carried in millions.

Explanation of French term : Millions de tonnes = Millions of metric tons.

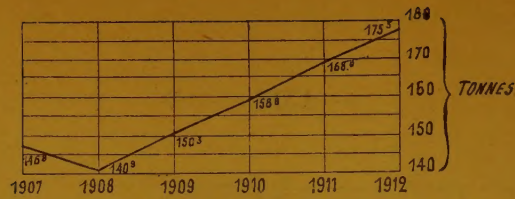


Fig. 3. — Average useful load carried per goods train.

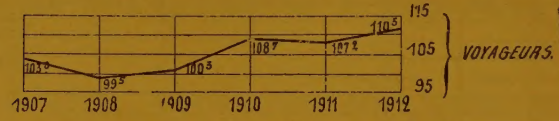


Fig. 4. — Average number of passengers carried per passenger train.

Explanation of French terms of figures 3 and 4 : Tonnes = Metric tons. — Voyageurs = Passengers.

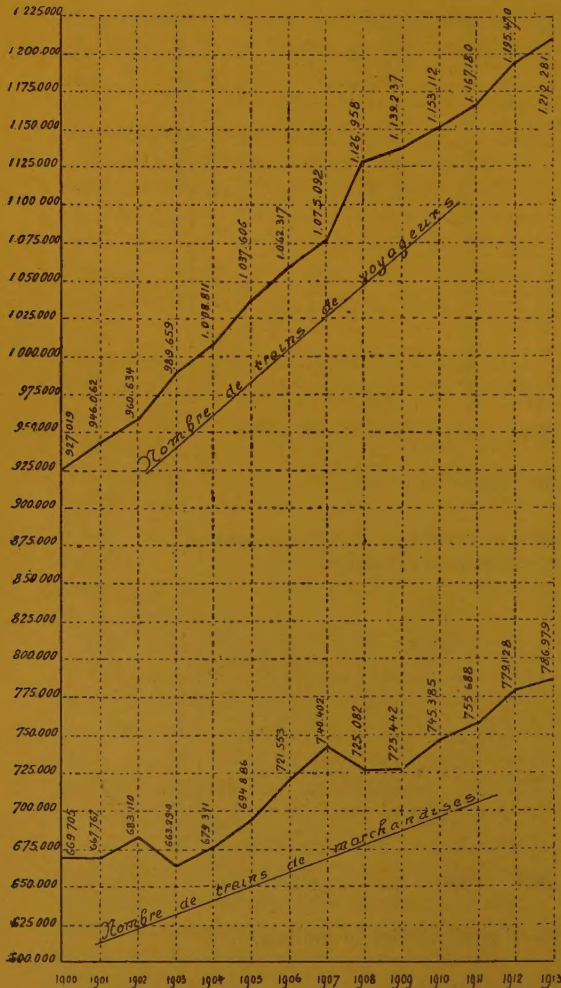


Fig. 5. — Diagram showing relative annual numbers of trains run.

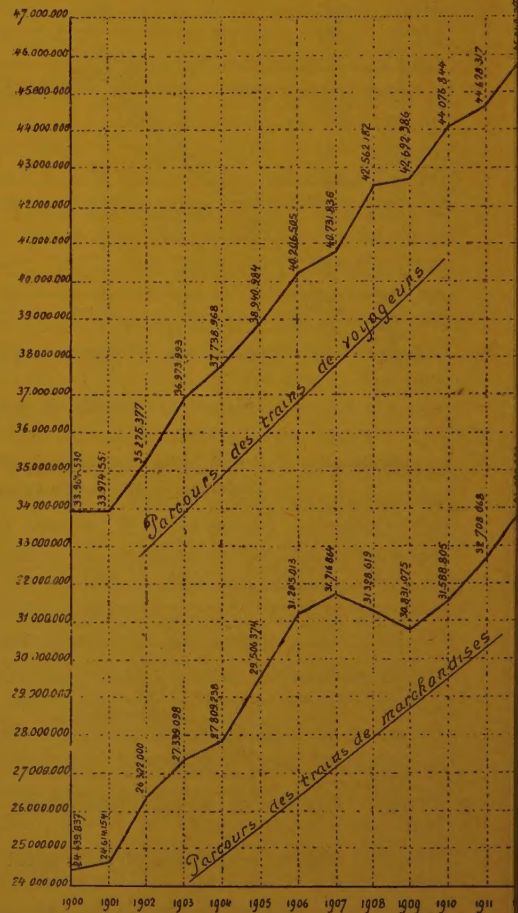


Fig. 6. — Diagram showing the relative annual number of kilometres run by the trains.

Explanation of French terms of figures 5 and 6 : Nombre de trains de voyageurs = Number of passenger trains. — Nombre de trains de marchandises = Number of goods trains. — Parcours des trains de voyageurs = Total yearly distance run by the passenger trains. — Parcours des trains de marchandises = Total yearly distance run by the goods trains.

TABLE 1.

Type of trains :		Mean per day :		Increase in ten years.
		in 1908.	in 1913.	
<i>Passengers.</i>	Number	2 710	3 320	22 %
	Distance run in kilometres. .	101 370 km.	128 770 km.	27 %
	Mean distance run per train	35 km.	36.9 km.	5.4 %
<i>Goods</i>	Number	1 820	2 160	18 %
	Distance run in kilometres. .	73 970 km.	95 890 km.	29 %
	Mean distance run per train .	41 km.	45.1 km.	10 %

Figures 5 and 6 show the variation in these details during the whole period under consideration ⁽¹⁾.

The drop which follows from 1908 in relation to goods trains is explained by the following reasons :

After the congestion of the winter of 1906-1907, the Traffic Management, finding that the working of the trains was becoming more and more difficult, took definite steps to make up heavier goods trains with a view to reducing the number of trains. The Traction Service increased the power of the locomotives in order to assist this scheme.

If the year 1908, the year of the crisis, is left out of account, it is found that the reduction in the number of trains, notwithstanding greater traffic, made itself felt particularly in 1909 in which the curve drops back to the figure of 1907.

During the following years, after the scheme had been established, the curve for the number of goods trains increases owing to the increase in traffic, but it takes a line of smaller inclination.

This enormous traffic on the Belgian

State Railways was of course divided very unequally over the whole of the railway system; the lines from Brussels to Arlon, Brussels to Herbesthal, Brussels to Antwerp and those of the lower Sambre in particular carried the larger portion.

If it is remembered that the line from Brussels to Arlon has a succession of up and down grades of 16 per mil, and that the line from Brussels to Herbesthal has at Liege the Ans incline of 33 per mil (1 in 30), the difficulties encountered by the Belgian State Railway on these lines at the commencement of each winter will be readily understood.

It happens at this period that :

- 1° the beetroot season is at its height ⁽¹⁾;
- 2° the transport of domestic coal increases;
- 3° as a precaution against and on account of frost which stops the traffic on the rivers, the consignors cease to use water transport and send their goods by rail;

⁽¹⁾ In 1913, during the sugar season, the work was done by 60 000 wagons for carrying beetroot and 45 000 for carrying pulp.

⁽⁴⁾ The figures given show the *annual* traffic.

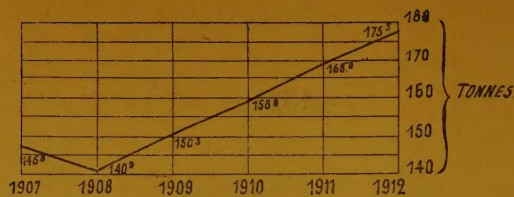


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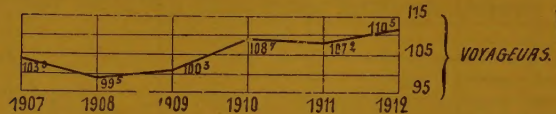


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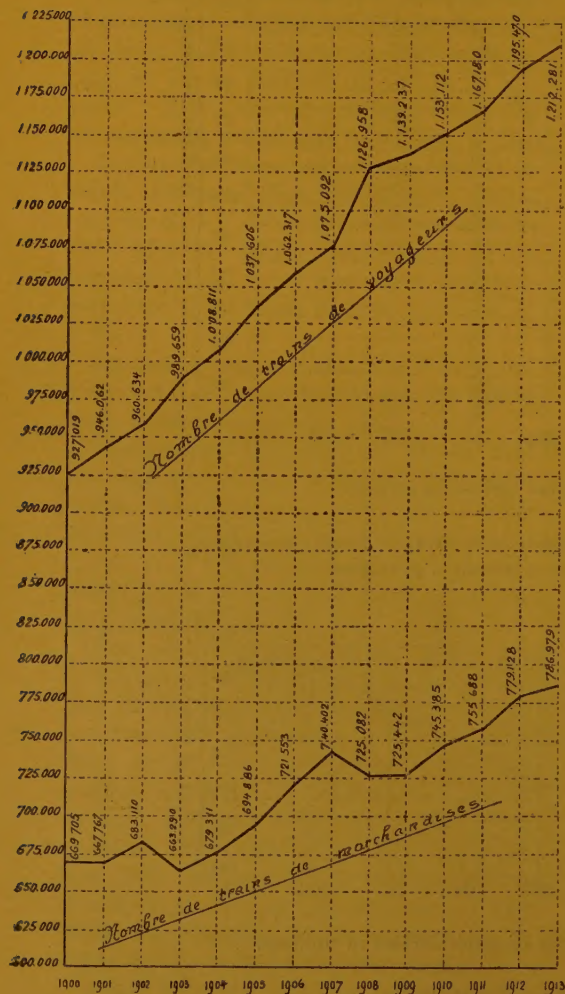


Fig. 5. — Diagram showing relative annual numbers of trains run.

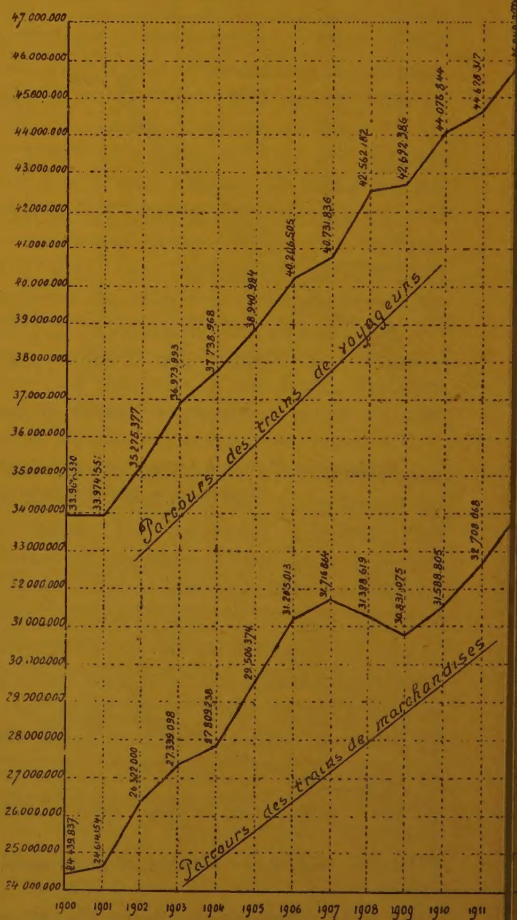


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4° the fogs slow down the traffic so that trains are delayed;

5° snow and frost disturb the shunting operations in the marshalling yards by blocking the points, and by slowing down the movement of wagons on gravitation sidings;

6° frost causes damage to external parts of the locomotives;

7° bad weather brings with it a great deal of illness causing shortage in the traction and train staffs;

8° the nights are long and the efficiency of work is always lower by artificial light.

For all these reasons the working of railways becomes very difficult in win-

ter; a derailment, a broken coupling, or a disabled locomotive have a much more serious effect than at other periods; the time taken by trains on the journey becomes longer, the locomotives do not arrive at the proper time at their turning point to take hold of the train intended for their return journey, and the service becomes more and more disorganised; this causes congestion with which it is so difficult to deal, and which, during the last years before the war, frequently did not come to an end before the return of good weather.

These periodic difficulties were not peculiar to the Belgian State Railways, but the neighbouring railway systems suffered in a similar way and a remedy was sought on every hand.

CHAPTER II.

The traffic control offices in Germany and Belgium in 1914.

In 1912 the railways under the Cologne management suffered a crisis analogous to those which had left the worst impressions in Belgium (1906-1907 and 1913-1914).

As the result of this crisis it was found that the station-masters in Germany only took steps with regard to their own service and made arrangements to suit their own stations without troubling as to what might happen to their colleagues, or to the train staffs, or to the locomotives.

As the result of this method of working the locomotives were not properly maintained, the staff slept intermittently at stations unequipped with dormitories, or had to go to inns after being on duty for a period which sometimes amounted to or even exceeded twenty-four hours.

This want of system resulted in great expenditure.

As the intervention of the central administration generally took place late, the Germans considered the creation of a special branch with power to act immediately on the slightest cause and to combine the measures to be taken.

For the 1768 km. (1098 miles) of track, the Cologne management formed, in 1913, six traffic-control offices (*Zugleitungstellen*) situated at :

Cologne (Deutz),
Troisdorf,
Düren,
M. Gladbach,
Neuss,
Hohenbudberg.

The map (fig. 7) shows the distribution of these offices and gives the lines subjected to their regulation.

As will be seen, the control offices are arranged at the points of convergence of the important lines.

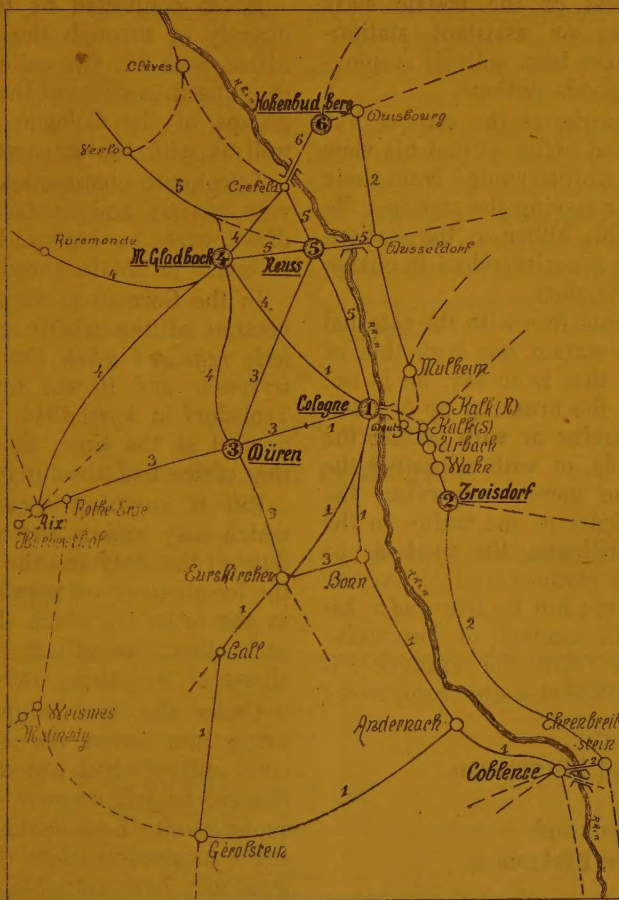


Fig. 7. — Traffic regulating stations in Germany.

These offices, except those of Troisdorf and of Hohenbudberg, are only used during the heaviest period in the year, that is to say from 1 September to 1 February.

It has been thought advisable to maintain permanently the two offices mentioned above in order to be able at any time

to overcome the difficulties which might be created by an interruption of the navigation of the Rhine and the fluctuations of output of the industrial basin of the Ruhr.

The officers in charge of the traffic-control offices (the *Zugleitungstellen vorsteher*) are directly responsible to the

superintendent of the traffic service.

These officers are recruited from amongst the best of the traffic staff (station masters or assistant station-masters) who have been actively employed in the large goods stations.

The officer works at the station, but in a special raised office so that his view of the trains is uninterrupted from their entering to their leaving the station. He is not responsible either to the station-master or to the superintendent in charge of the locomotive shed.

He does not interfere with the internal working of the station nor with that of the loco sheds, that is to say, he is not concerned with the breaking up or making up of the trains or with getting the locomotives ready, or with allocating the train staffs; he merely supervises the succession or order of the trains on the lines and co-ordinates the methods of working of the stations and locomotive sheds of his area; but he has *under his orders* a certain number of locomotive and crew units (three for example), it being understood that a unit comprises :

- one locomotive,
- a driver and his fireman,
- a van,
- a head-guard, and
- four to five brakemen.

The locomotives are, of course, housed in and run from the shed, but their use is decided by the officer responsible (or traffic-controller) alone.

He is equipped with everything to enable him to follow and to regulate the train service; he has plans of all the large railway stations in his area, time-tables, graphical charts, and instructions relating to the traffic service.

The plans are posted on the walls of the office; the regulations, the time-

tables, etc., inserted in covers, are hung within easy reach of his hand.

He is connected by telephone, either directly or through the Cologne central office, with his five colleagues, and with the superintendents of the thirteen service groups of the Cologne Management as well as with the Management itself.

Telephonic communication is effected very rapidly and as far as possible by direct wire; no expense has been spared in order to obtain speed.

In the German arrangement the intervention of the traffic control office is *only required when the service becomes irregular* and it was found on visiting Troisdorf in April 1914, the service being normal at the time, that the officer at this office had absolutely nothing to do.

But if anything occurs of any kind which may unduly extend the hours of duty of the staff and the distance run by the locomotives, or requires modification in the order in which the trains follow each other, the officer takes up his business of smoothing out the difficulties.

Under the first supposition he will bring into action the « locomotive and crew units » which are entirely under his charge; he will require their immediate replacement, if necessary he will demand the « locomotive units » that his colleagues may have available, and he may arrange with them for the use of « foreign » locomotive « units » which happen to be in his area under normal or accidental conditions.

Under the second supposition, that is in case of delay or of trouble in the order of running of the trains the traffic controller keeps himself posted, by telephone, as to the position in all the stations, as to wagons to be taken off, as to trains in sidings alongside the railway, as to loads awaiting clearance, and as to empty wag-

ons to be dispatched according to instructions from the distributing offices.

He thus decides as to the necessity for making up special trains and he knows those which are running; working in harmony with his colleagues he regulates the sequence of the trains; *in fine*, he co-ordinates the working of the stations and helps them when necessary by supplying means with which they are not equipped.

* *

In May 1914, the Administration of the

Belgian State Railways decided to establish « traffic control offices » on the model of the German system.

The employees working these traffic regulating offices were to some extent « dispatchers ».

The Belgian State Railways chose for their experiment the line from Schaerbeek to Arlon and established traffic control offices at Schaerbeek, Jemelle and Arlon. The installations were in course of being carried out and the « dispatchers » had been selected when the war broke out in August.

CHAPTER III.

After the war in Belgium.

At the present time, some idea of the activity of the Belgian State Railway System can be obtained from table 2.

TABLE 2.

YEARS.	Number of passengers carried.	Number of tons of goods carried (full loads only).
1913.	202 500 000	61 500 000
1920.	204 800 000 (101 % of 1913)	50 250 000 (81 % of 1913)
1921.	222 300 000 (110 % of 1913)	50 500 000 (82 % of 1913)
YEARS.	Number of passenger trains.	Number of goods trains.
1913.	1 212 000	849 000
1920.	609 000 (50 % of 1913)	555 000 (65 % of 1913)
1921.	728 000 (60 % of 1913)	559 000 (66 % of 1913)
YEARS.	Distance run by passenger trains in kilometres.	Distance run by goods trains in kilometres.
1913.	45 977 000	35 564 000
1920.	26 589 000 (51 % of 1913)	26 052 000 (73 % of 1913)
1921.	30 981 000 (67 % of 1913)	24 854 000 (69 % of 1913)

During the year 1919 the State Railways were in full course of reorganization; in 1921 the economic crisis existed in full

intensity; reference will be made specially to the traffic in 1920.

It will be seen on examination of the

preceding table that, during this financial year, the Belgian State Railways carried rather more *passengers* than in 1913 and this was done with only 50 % of the number of trains that were running in 1913, these trains, moreover, only ran 51 % of the number of kilometres run in 1913.

These results are due on the one hand to the use of more powerful locomotives, but mainly, owing to the shortage of rolling stock to the full utilization of the seating accommodation of the trains.

With regard to the *goods* service it is found that the number of tons carried in 1920 represents only 75 % of the corresponding figure for 1913. For this traffic only 65 % of the number of trains run in 1913 were at work, and these trains only ran 73 % of the distance run by goods trains in 1913.

The relative reduction in the number of trains is due to increased tonnage of the wagons, increased power of the locomotives, and better utilization of the wagons owing to modifications introduced into the bases of the tariffs.

For the whole of the passenger and goods traffic, the number of trains and the distance run in kilometres were, therefore, less in 1920 than in 1913. Now, notwithstanding this reduced traffic, difficulties similar to those encountered

before the war occurred again in the course of the winter of 1920-1921. The causes are not well defined; but they may be in part attributed to the inexperience of the staff which was hastily recruited after the Armistice, in part to the enforced introduction of slower time-tables, and in part to the difficulties inherent to the application of the eight-hour day. If this measure has some benefit to its credit from the humanitarian point of view, on the other hand, so far as the railway working is concerned, it makes the arrangement of the « runs » of locomotives and of the train-staffs a more difficult matter; it requires much more frequently that the haulage of the trains should be done by a change of crew and this increases the time during which the tracks are occupied in the stations; it also has some effect in slowing down the turnover of the rolling stock.

The difficulties of the winter of 1920-1921 brought the question of re-establishing the traffic-control offices into first importance.

Moreover, the French railways, which had seen the Americans at work during the war, began to equip their lines with the « dispatching system » and to consider the question as to whether this method of working was not an improvement on the existing arrangement.

CHAPTER IV.

« Dispatching » in America.

In America, for long past, the « dispatching system » has been in general use; the system was known on the Belgian State Railway and on other railway systems on the Continent.

But if this system was only in use in

Europe on the English railways, modified so as to adapt it to their methods of working, it was because the European methods differ essentially from the American methods.

On the American railway systems, the

ordinary goods trains have no fixed timetable as in Europe; this goes so far that they may be described as « wild » trains! Time-tables are not laid down, apart from those of the passenger trains, with the exception of *fast goods* trains carrying live stock, fresh meat, fruit, vegetables and all other produce carried in refrigerator wagons.

Under these conditions the ordinary goods trains are dispatched as the tonnage at the station becomes nearly equal to the power of the locomotive available. The « chief dispatcher » then dispatches the train and decides how far this train will run before meeting another or being

passed, at what stations it will pick up certain goods, and he lays down the stations that the train will run through without stopping, etc.

To do this the « dispatcher » is warned, formerly by telegraph, now by the telephone, of all that concerns the train service on the line. He knows at each moment the trains that are running, their loads, the locomotives that haul them, the class of goods carried, the wagons which must be picked up or taken off at the stations.

All the trains are equipped with portable telephone apparatus and contact makers (fig. 8 — extendible bamboo rods



Fig. 8. — Portable telephone set of apparatus.

with flexible wires and plugs corresponding to sockets on the posts — and by means of telephone stations arranged along the track the train staff can, at any

moment, get into communication with the « dispatcher » (fig. 9).

The telephone stations on the track may be fitted with a small semaphore (fig. 10)

worked by the « dispatcher » which signals to the train staff that a stop must be made to take the orders of the « dispatcher ».



Fig. 9. — Telephone box alongside the railway.

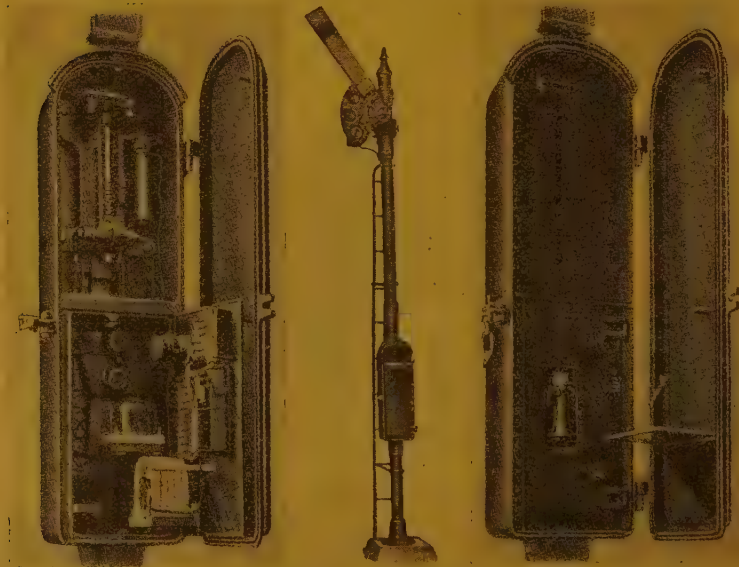


Fig. 10. — Semaphore fitted with telephone box.

This system conforms completely to the enormous distance between stations, the conditions of American working. The inevitable delays with stations so far

apart, and the much greater distances run by the trains justify the departure from regular time-tables.

On the greater part of the European railway system and in Belgium in particular, conditions are quite otherwise; on account of the density of the population, the stations are much nearer together (averaging 3 km. [1.9 miles], in Belgium).

The station-masters by checking the trains prevent them from getting ahead of the time-table and by shortening the time of standing in the stations, they tend to bring trains that are late up to their normal times.

Moreover, in Europe there are more double and quadruple tracks than in America, and a deviation from the time-table usually only involves a change of order of sequence of the trains, a train which has become delayed being easily passed by faster traffic.

In America the distances between the stations are often very great; the traffic on single track railways is generally very heavy; delay to a train on such lines involves a change of the point at which it passes another train, an operation which is made more difficult because there are sidings or side-tracks off the main track, that is to say, outside the supervision of the station.

It will be understood that under such conditions of working the output of a line is a function of the manipulative qualities of the « dispatcher ».

It must also not be forgotten that, up to the last few years, the *telegraph* was exclusively used in America for managing the traffic service, and that the intervention of the *telephone* only dates from 1907.

Now the telephone has the following advantages over the telegraph :

The telephone can be used indifferently by all railway servants whereas the telegraph requires special operators. The orders are transmitted and received direct in ordinary language, whereas the telegraph generally requires two intermediaries and two translations, one from the ordinary language into conventional signs and the other in the opposite sense; the transmission and the reception of messages by telephone are incomparably more rapid than by telegram. The telephone immediately puts into contact the chief, who is giving the orders, with his subordinate who must carry them out, and finally it allows of the communication of elaborate particulars the greater precision of which, obtained by actual conversation, would be impossible to ensure by telegraph.

CHAPTER V.

« Dispatching » in France during and after the war.

The United States declared war on Germany on 6 August 1917 and as the entry of the first American division into action on the Lorraine sector was only arranged for the spring of the following year it was during 1918 in particular that the

Americans organized the transport of their troops and their armament through French territory.

This explains the fact that it was only at the moment of the Armistice, in November 1918, that they commenced a first

application of the « dispatching system » on the Saint-Nazaire to Saumur section of the Orleans Railway System. This

section was afterwards extended through Saint-Pierre-des-Corps (Tours) to Givèrres (fig. 11).



Fig. 11. — Map of French railways.

Explanation of French terms : Légende = Explanatory note. — Lignes équipées au « dispatching » = Lines equipped for « dispatching ». — Lignes à l'étude pour 1922 = Lines proposed to be equipped in 1922. — Lignes de démarcation des réseaux = Boundary lines of the railway systems.

The first section Saint-Nazaire-Saumur had been chosen because the Americans arrange their « dispatching » section ac-

cording to the longest distance run by the locomotives.

When they had brought a sufficient

number of locomotives, of wagons and staff to Europe ⁽¹⁾, the Americans took steps to secure an organization which was as autonomous as possible; the principle was that the American train was loaded and made up by American employees, in special stations reserved for American transport, and was equipped and hauled by an American locomotive and crew.

On the French lines the train ran with a French conveyor. Its make-up (tonnage, length and brakes), and its route were arranged according to the French rules; but the relays of locomotives and staff were effected according to American regulations in American stations.

Actually the Americans compelled their goods trains to follow a pre-determined time-table, according to the French method, but they managed the regulation of the running of the trains on the line by making a special employee, the « dispatcher », responsible for co-ordinating both by night and by day the work of the stations of the section, and they put the « dispatcher » in possession of improved telephonic apparatus used in America and known as « selectors », telephones which made extra rapid communication between the « dispatcher » and the stations.

At the end of the war the Americans left the special telephone equipments on the Orleans railway system, and the other French railways in turn subjected the new system to trial.

The French State Railways and the Paris-Lyons-Mediterranean Railway in particular gave great attention to « dispatching » and they adopted it but allott-

ed different functions to the role of the « dispatcher ».

The French State Railway adopted « dispatching » to avoid the disturbances which resulted from the frequent heavy fluctuations in the traffic occurring in the service to several ports as well as disturbances due to seasonal traffic, whereas the Paris-Lyons-Mediterranean railway, which is not subject to these disadvantages, adopted « dispatching » to compensate for the lack of experience in a large number of new employees that had to be taken on after the war.

In general principle the system in use on the two railways is the same; the « dispatcher » is assisted by operators who receive and send all communications relating to the movements of the trains.

With this object, on the one hand, they are equipped with « selector » telephone apparatus which enables them to make practically instantaneous communication, and on the other hand the operator draws the actual position of the trains on a clean chart on *diagram*, as and when the particulars are received.

The only important difference between the « dispatching » of the French State Railway and that of the Paris-Lyons-Mediterranean is that on the State Railway, the « dispatcher » appears to be possessed of some moral authority over the station-masters, which allows him, if necessary, to give orders; whereas on the Paris-Lyons-Mediterranean the office of the « dispatcher » is considered rather as being « an information bureau » to which the stations and locomotive-sheds may refer when they are uncertain of the position or composition of the train they are expecting. They make great use of the arrangement.

The German traffic regulators were already in possession of rapid telephonic facilities and it had been recognised that

(1) At the Armistice, in November 1918, there were in France : 1 000 American locomotives, 14 000 American wagons, 6 300 American railway employees; in June 1919, although the number of employees had been reduced to half there were : 1 500 American locomotives running and 20 000 American wagons.

these formed the feature essential to the success of their enterprise. The French telephonic apparatus is much more highly developed.

These, which are of the « Western Electric Company's » type are of American make.

The following is the principle upon which they work :

A double-wire telephone line, common to all the stations on the section, is connected at one point of its length to a main office, that of the « dispatcher ».

The « dispatcher » by means of selector keys suitably arranged, can, at will, call any one of the stations without disturbing the others. When the « dispatcher » turns the key for calling a station, the mechanical-electrical system acts in such manner that the bell rings at that particular station alone.

A special key enables all stations to be called at once, and these can then receive simultaneously the same communication from the « dispatcher ». It is to be noted that each station puts itself in communication by merely unhooking its apparatus.

The operator « listens-in » all the time on the line; he wears a telephone receiver with head-band and carries a microphone chest transmitter.

When several stations call at once, the « dispatcher » decides which shall speak first.

The German traffic-controllers received particulars in a similar way enabling them to follow the running of the trains step-by-step, but these particulars were written down as transmitted in notebooks, whereas in France, they are plotted graphically; the difference that exists between the two methods is the whole difference between the inspection of a *book* of the trains and inspection of a *graphical diagram*. The actual graphical

diagram compared with the theoretical graphical diagram enables the running of the trains to be grasped at a glance, and their relative position on the line to be determined; for this reason it is a most useful document.

The actual graphical diagram, moreover, enables the theoretical diagram to be modified subsequently, and it is of valuable assistance in examining the causes of irregularities. It is thus that the numerous operators on the French State Railway deal with irregularities when they are not on duty on the telephone apparatus.

The French « dispatching » system is essentially an organization dependent on the traffic service; the French railways have thought it superfluous to supplement the « dispatcher » by an employee of the traction service. Moreover, the « dispatcher » only has to do with the movement of the trains, he does not have to do with the internal work of the stations, but he serves as a valuable information agency for these and also for the locomotive sheds.

The « dispatcher » is informed — when a train leaves — of the time of its departure, of the make up of the train, so many wagons for X, so many for Y, of the number and type of the locomotives, and of the shed to which they belong; he notes these particulars on the graphical diagram and transmits them to the stations and sheds concerned.

Very frequently under the present condition of the telephone service, an intermediate station is waiting to shunt or is holding a goods train on a siding for a fast train that is late. The position of the fast train on the line is not known at the station, and very often it would be possible to carry out the shunting operation or to allow the goods train to run forward to the next siding, provided that

the station were informed in *time* and *accurately* as to the amount the fast train is late. This information would be given at once and definitely by the « dispatcher ».

A station, at which passing would take place, on being informed by the « dispatcher » of the arrival of a goods train *short* of so much tonnage, would send away by this train those wagons for which it would have had to run an optional or a special train.

A locomotive shed would be informed by the « dispatcher » as to the position of its locomotives on the line or would be warned in the case of breakdown of one of its engines.

The « dispatcher » who can see on the graphical diagram that a train is falling behind the time-table, ascertains the cause from one of the stations through which it runs; if he finds, for example, that the locomotive is short of steam, he informs the shed on the section ahead which gets a spare locomotive ready, etc., etc.

Thanks to *instantaneous* telephonic communication and to the graphical diagram of the running of the trains it may be said that the « dispatcher » can *see* the movement of the trains on the line; and it matters very little that his office should be arranged in the centre of a station. At the (Paris) Montparnasse station it is placed in the inspection offices and does not look out on to the station at all. On the Paris-Lyons-Mediterranean Railway the « dispatchers » have their offices in stations, but without a look-out over the station:

On the *French State Railway* « dispatching » was installed in the Montparnasse station for the Paris-Chartres section (87 km. : 54 miles) (fig. 11) on 15 June 1920; this section was extended in the direction of Le Mans and two new

sections were made towards the north of the system, the one from Paris to Mantes through Poissy and the other through Argenteuil (120 km. : 75 miles), and then the Paris-Chartres section was lengthened to La Loupe (34 km. : 21 miles).

On the *Paris-Lyons-Mediterranean* two « dispatchers » offices have been installed side by side at Châlon-sur-Saône since 10 September 1920; the first controls the Dijon-Châlon section (68 km. : 42 miles), the other the Châlon-Lyons section (129 km. : 80 miles). It has been decided to install « dispatching » in successive stages from one end to the other of the Paris-Marseilles line, and the Dijon-Les Laumes (58 km. : 36 miles) and Paris-Montereau (78 km. : 49 miles) sections have already been equipped.

The *French Eastern Railway* established the Nancy-Avicourt section (157 km. : 98 miles) at the commencement of 1921 with the Blainville-Epinal branch (74 km. : 46 miles). « Dispatching » was then extended on to the Nancy-Pagny-sur-Moselle section (38 km. : 24 miles), the Nancy-Pont-Saint-Vincent-Toul section (41 km. : 26 miles), and the Nancy-Nançois (88 km. : 55 miles) section, with the Toul-Barisey branch.

Apart from the Saint-Nazaire-Gièvres section the *Orleans Company* installed « dispatching » on the Orleans-Brétigny section in September 1920 (90 km. : 56 miles). Later on, the Montluçon-Saint-Sulpice-Limoges (123 km. : 76 miles) section was equipped.

The *French Northern Railway Company* made a commencement in 1920 with the sections : Longueau-Arras, Longueau-Estrées, Longueau-Etaples, Longueau-Creil (330 km. : 205 miles).

The *French Midi Railway* system equipped the Narbonne-Béziers-Cette

section (70 km. : 44 miles) in February 1922.

Finally, projects are in hand : on the State Railways between Motteville-Rouen-Saint-Pierre-du-Vauvray, on the French

Eastern Railway on the Mézières-Charleville section.

All these lines are or will be equipped with selector apparatus made by the « Western Electric Company ».

CHAPTER VI.

« Dispatching » in Belgium.

We had seen the traffic-regulating offices at work in the Cologne district in April 1914. In May 1921 we had the opportunity of examining the « dispatching » system on the French State Railway which had begun work in June 1920, and that of the Paris-Lyons-Mediterranean which had been equipped in September 1920. Now the French « dispatching » system differed from the other by improvements of such magnitude that the question of choice between the two systems did not arise.

§ 1. — The first trial on the Brussels-Namur line.

In face of these facts the Belgian State Railway Administration decided in June 1921 that it was necessary to resume the trial of « dispatching » which had been sketched out at the moment war broke out, and that full advantage should be taken of all the improvements that had been introduced on the French railways, that is to say :

1° Equipment of the American telephonic apparatus known as « selectors » ;

2° Graphical diagrams made by the « dispatchers » for the actual running of the trains.

Differing from the practice of the French State Railway and conforming with the practice of the Paris-Lyons-Me-

diterranean Railway it was decided that the locomotive sheds should be in direct telephonic communication with the « dispatcher », the latter being of course under absolute instructions never to call out a locomotive without permission from the owner shed.

It was also decided that the « dispatcher » should be installed in the offices of the local traffic service manager⁽¹⁾.

§ 2. — Particulars of the system.

As it has been shown, the « dispatching » system consists in entrusting the management of *the running* of the trains, inside a particular area, to a special employee, the « dispatcher », who, from a central office fitted with the necessary equipment, can give at any moment the required information to enable regularity of the service to be maintained or re-established.

The « dispatcher », therefore, does not enter into the internal work of the railway stations; his essential function is to regulate the running of the trains on the line, so as to eliminate causes of delay and avoid blocking. Safety is ensured apart from him by the signal system, the drivers being required to act in obedience to the signals.

The « dispatcher » carries out, in fact,

(1) The Belgian State Railway has 11 local traffic districts for its 4368 km. (2 714 miles) of line.

a *single control* by co-ordinating the measures to be taken by all the station-masters spread over the line.

In America the « dispatcher » is in relationship with the chief conductors of the trains; in France and in Belgium his relationship is with the station-masters who, on the Continent, are responsible for the actual running.

The trials were limited to the Brussels (Nord)-Namur section and the office was arranged in Brussels (Nord) station, where the service works continuously day and night. It is under the direction of the « *chief dispatcher* », who is himself assisted by three « *dispatchers* » each working an eight-hour shift. Each « *dispatcher* » is assisted by an « *operator* ».

The service is so organized that the « *dispatchers* » and the operators can travel at least twice a month over the line with a view to keeping themselves posted in the modifications that have been made in the station equipments or in the method of working at the stations.

The functions of the « *dispatcher* » are as follows :

1° He combines the information relating to the movement of the trains and locomotives; he repeats to stations on his section the information received and he makes suitable suggestions to them;

2° He gives information to shunting stations, to stations where locomotives are changed, and to the locomotive sheds, relating to the load and the conditions of haulage and of service of *special trains*. He informs them of the modifications which have been made in the haulage and service of the *regular trains*;

3° He repeats over the line the *announcements of probable delays* and those of *trains past which* he receives from the station.

Moreover, he ascertains the actual delay of trains entered on the section and informs the stations of this;

4° When the shunting stations find difficulty in receiving the trains, he arranges the measures that must be taken on the line to ease the situation and he gives orders to the stations where the trains are made up and those that are run through so as to take off, or delay, or send round, or place temporarily on a siding any trains which might block the line or the stations destined to receive them;

5° He acts as a liaison officer between the stations and the locomotive sheds for removing trains that have been left on sidings and of which the locomotives have been sent back to the sheds.

He suggests arrangements to the locomotive sheds to enable the locomotives to be used when these have been sent down the line on special work;

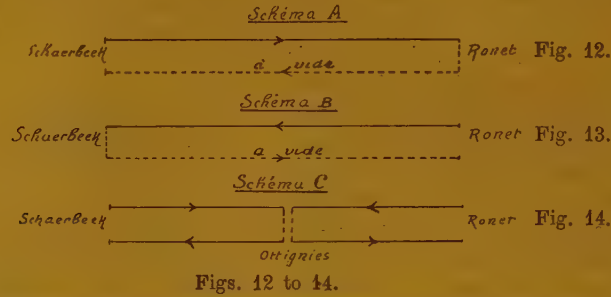
6° He expedites the work of the locomotive sheds by accelerating the running of the trains and of the locomotives, by reducing the time the locomotives are standing in the stations, by informing the locomotive sheds of the running and of the probable time of return of locomotives running light, and by naming the trains on which the locomotives have to be changed, etc.

An example will show the full economic importance of his functions.

Let us take the case of a locomotive hauling a special train from Schaerbeek to Ronet. If there is no load to be picked up at Ronet at the time when this locomotive takes the road to Schaerbeek, it is probable that the return journey will be run light from one end of the line to the other (fig. 12). The same would occur with a locomotive from Ronet which would have hauled a special train

for Schaerbeek (fig. 13). The « dispatcher » who is himself familiar with the special trains that have to be worked, will arrange the departure of these trains in such manner that they meet at Ottignies, at Gembloux, or at some other station, where the locomotives will be chang-

ed (fig. 14), those from Ronet taking over the train that had been hauled by those from Schaerbeek and *vice versa*; all running light will thus be avoided, and as it is a case of double-headed trains a distance of $4 \times 64 = 256$ km. (159 miles) of running light will have been saved.



Explanation of French terms : Schéma = Diagram. — A vide = Running light.

Another example :

If a locomotive is running light from Namur to Ottignies the « dispatcher » will use it, for instance, to pick up a load at Rhisnes for Gembloux, etc.

Making the graphical diagram.

As in France, the Belgian « dispatcher » draws the actual diagram of the running of the trains; with this object he marks on a canvas sheet the times of departure of the trains or of the locomotives and, as they move, the times at which they pass the different stations or cabins.

The passenger trains are shown on this diagram as *black* lines, goods trains as *blue* lines, the runs made by light locomotives as *black dotted* lines and the trains run on « siding lines » as *red* lines.

The graphical chart enables all errors in running the traffic to be seen and shows particularly the lost time that occurs in the stations and while running.

The « dispatcher » is, for example,

warned by the chart when a long delay takes place to a train on the open track, or when a train is running irregularly, etc.

As the « dispatcher » has under his eyes, the whole time, the position of the trains on the line *plotted exactly* he can inform the stations accurately regarding them.

From this the stations can better select the time at which an operation entailing the use of one of the main lines may be undertaken; they can determine which siding a train can reach when passing another, and they know definitely whether a certain siding is free or otherwise.

The « dispatcher » adds to his daily graphical diagram the list of irregularities which he has found. The office of the director of traffic service compares this graphical diagram with the guards reports, notes the irregularities and, if necessary, endeavours to find suitable modifications to be made in the time-tables.

The station-masters are guided by the magnitude of the delays announced so that they may hold up slow trains which

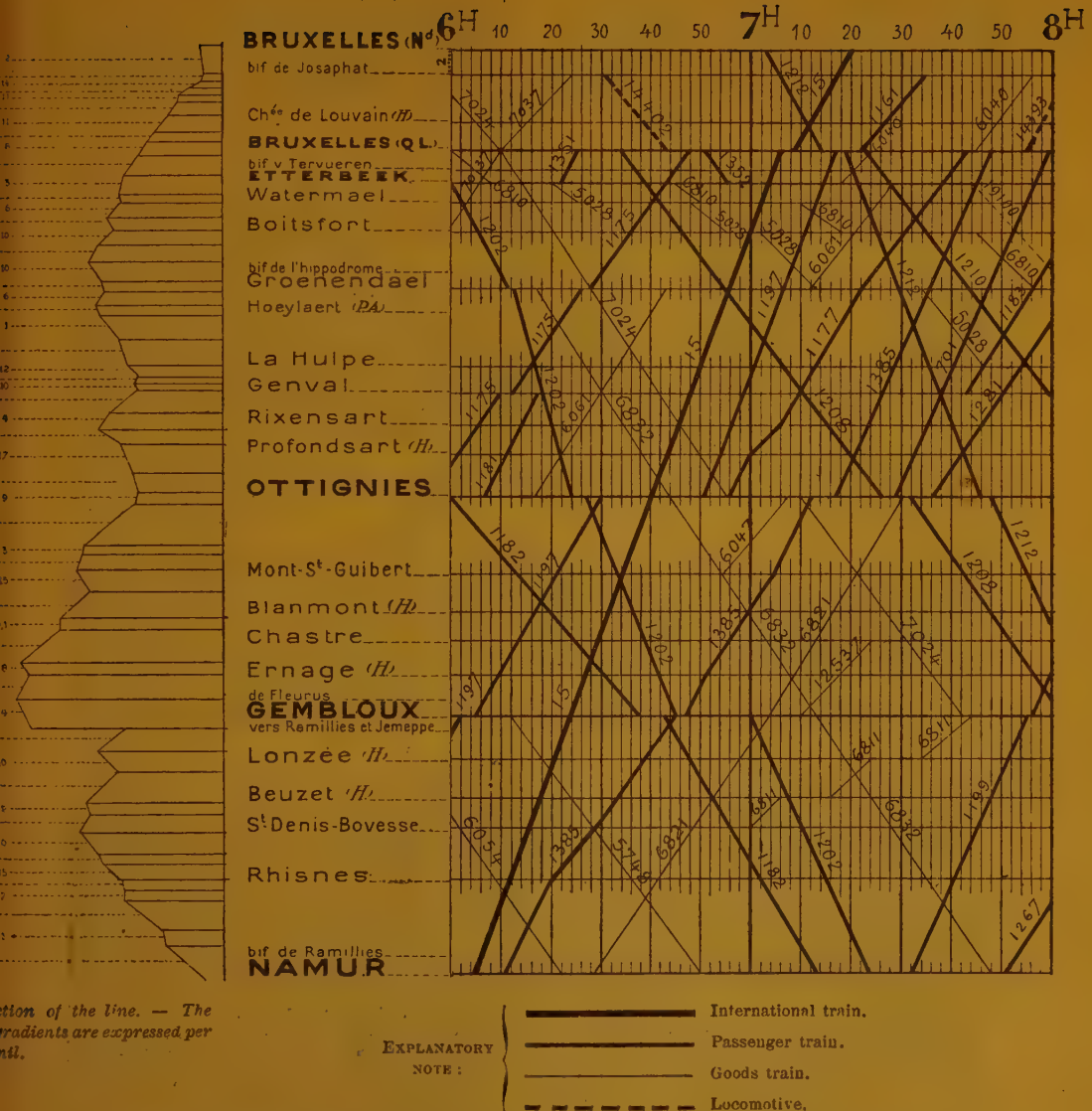


Fig. 15. — Excerpt from the graphical diagram arranged for the regular train-service run on the Brussels-Namur line between 6 and 8 a. m.

Explanation of French terms : Bif. de Josaphat = Josaphat junction. — Bif. de Tervueren = Tervueren junction. — Bif. de l'Hippodrome = Hippodrome junction. — Vers Ramillies et Jemeppe = To Ramillies and Jemeppe. — Bif. de Ramillies = Ramillies junction.

should be run into sidings in order to allow the express trains to pass them.

These modifications in putting trains into sidings can only be done intelligently if notice of the delays are given in good

time and with accuracy. When in doubt a station may hold back a train which it could have pushed on along the line if it had been in possession of better information.

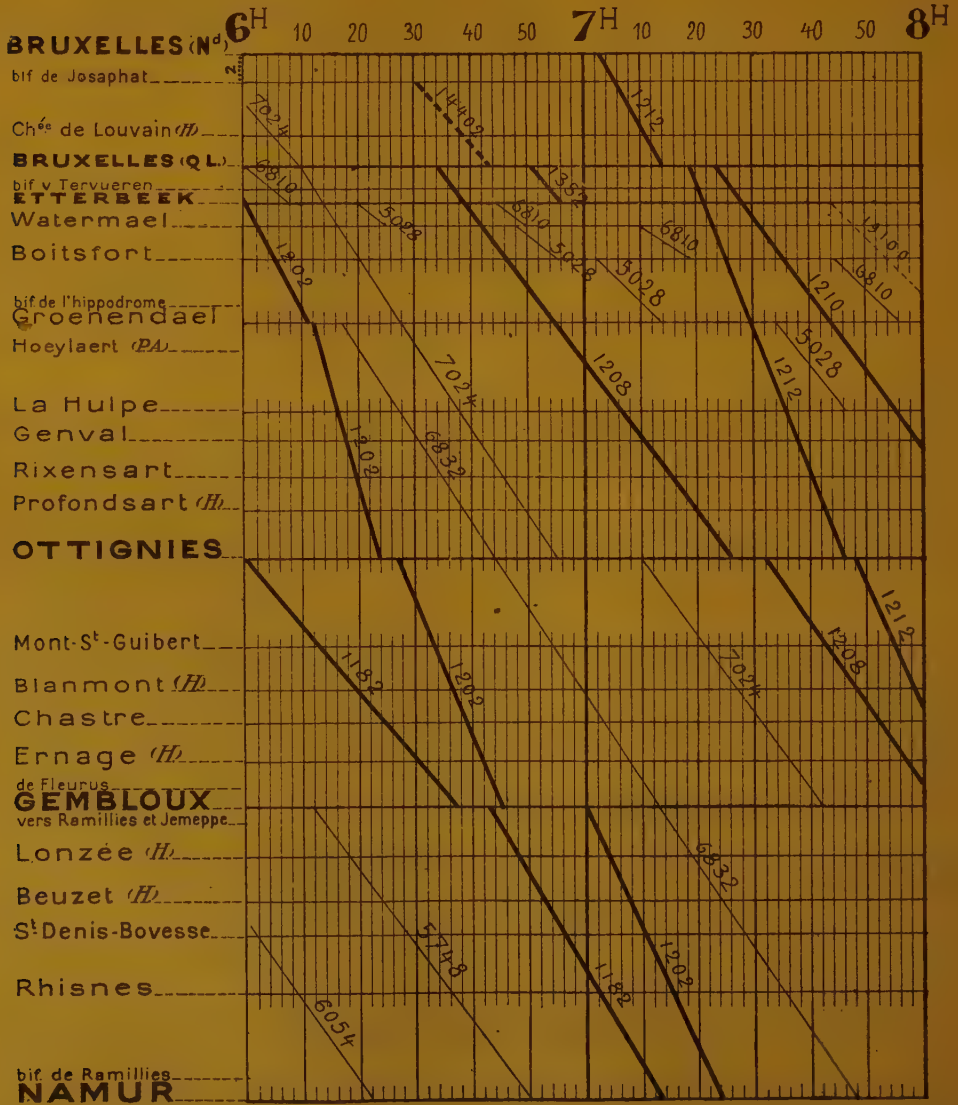
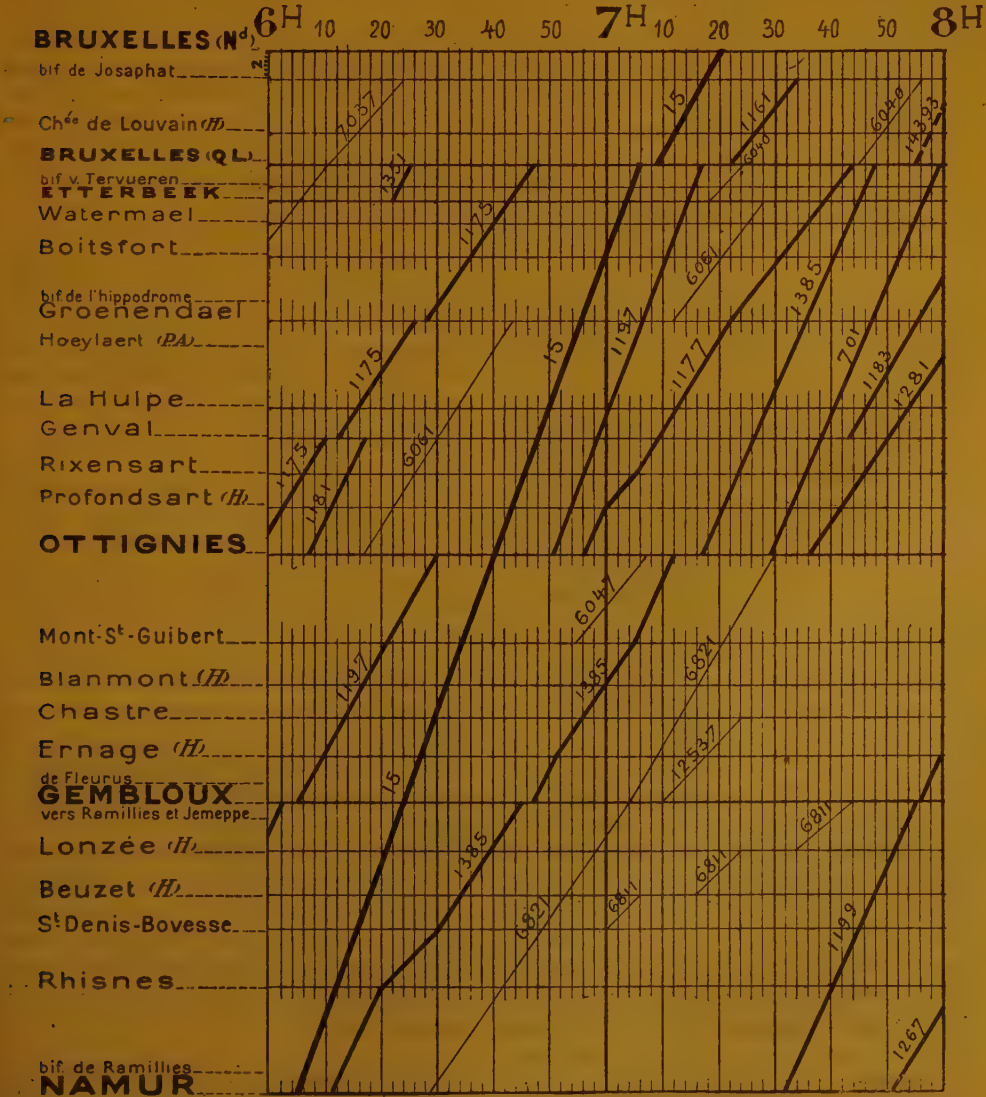


Fig. 16. — Excerpt from the graphical diagram arranged for the service from Brussels (N.) to Namur.

As the uncertainty is renewed at each place at which a slow train must be put into a siding to allow an express to pass the delay continually increases.

When the telegraph is used the infor-

mation frequently arrives too late for the station employees to be able to make use of it advantageously. This is because the telegram announcing the delay is handed to the telegraph operator who transmits



it in rotation after the telegrams he has already in hand. On their receipt an employee sometimes waits for more telegrams before delivering them to the station-master who may be out along the sidings. It is not uncommon for the announcement of the delay to arrive at the same time as the train itself!

The graphical diagram gives *precise* data as to the magnitude of the delay, and the telephone enables this to be transmitted *rapidly*.

Figure 15 shows the graphical diagram for trains running in both directions between Brussels and Namur and between 6 and 8 a. m.

Figures 16 and 17 show the same graphical diagram analysed for direction of running. The heavy line shows an international train, No. 15, and brings out in a striking manner the well known fact that express trains cause a void before and behind them. Finally, figures 18, 19 and 20 show the *actual* graphical diagram as drawn by the « dispatcher » as and when he receives the announcement of the passing of the train from the different signal-cabins or stations.

These graphical diagrams refer to 23 March 1922.

They are worth a brief examination; it is to be noted in particular :

1° *Direction Namur-Brussels* (up-line) (fig. 19). — A. The running *through* Ottignies at 6.16 a. m. of a special train from Ronet to Schaerbeek because the « dispatcher », warned of the difficulties that affected the internal working of the services at Ottignies, has instructed that the wagons intended for Ottignies shall be left at Mont-Saint-Guibert, whence they will be sent on, at 6.50 a. m. by train No. 6047;

B. The introduction, at Ottignies, of

three other trains (No. 6061, a special, and No. 1181) between the train numbered 2910 in the time-table running at 5.58 a. m. and train No. 15 at 6.39 a. m., which means four intervals into which 41 minutes were divided;

C. The sending, through Ottignies, of train No. 6061, 8 minutes early, which enabled this train to be run on to Etterbeek, whereas it usually passes trains Nos. 15 and 1197 at Groenendael; by this means, No. 6061 arrived at Brussels (Q.-L.) 41 minutes early;

2° *Direction Brussels-Namur* (down-line) (fig. 20). — A. Train No. 5028, which is given on to the section of the « dispatcher » 1 hour 14 minutes late arrives at Namur 32 minutes early (the portion of the diagram given does not allow this to be seen);

B. Train No. 6810, a stopping passenger train, the operations relating to which were complicated at the station at the commencement of its run, was brought up to time on leaving Saint-Denis-Bovesse;

3° If examination is made of *both directions of running combined* (up and down-lines) (fig. 18) it will be noticed, that at a very busy time, three special trains were enabled to run over the « dispatcher's » line from end to end and performing the run in particularly short time. Moreover, three other special trains are to be found running over a portion of the distance. Before the « dispatcher » was installed it would not have been possible to introduce a single special train at this time of day;

4° No locomotive is running light, they have all been used for hauling the special trains.

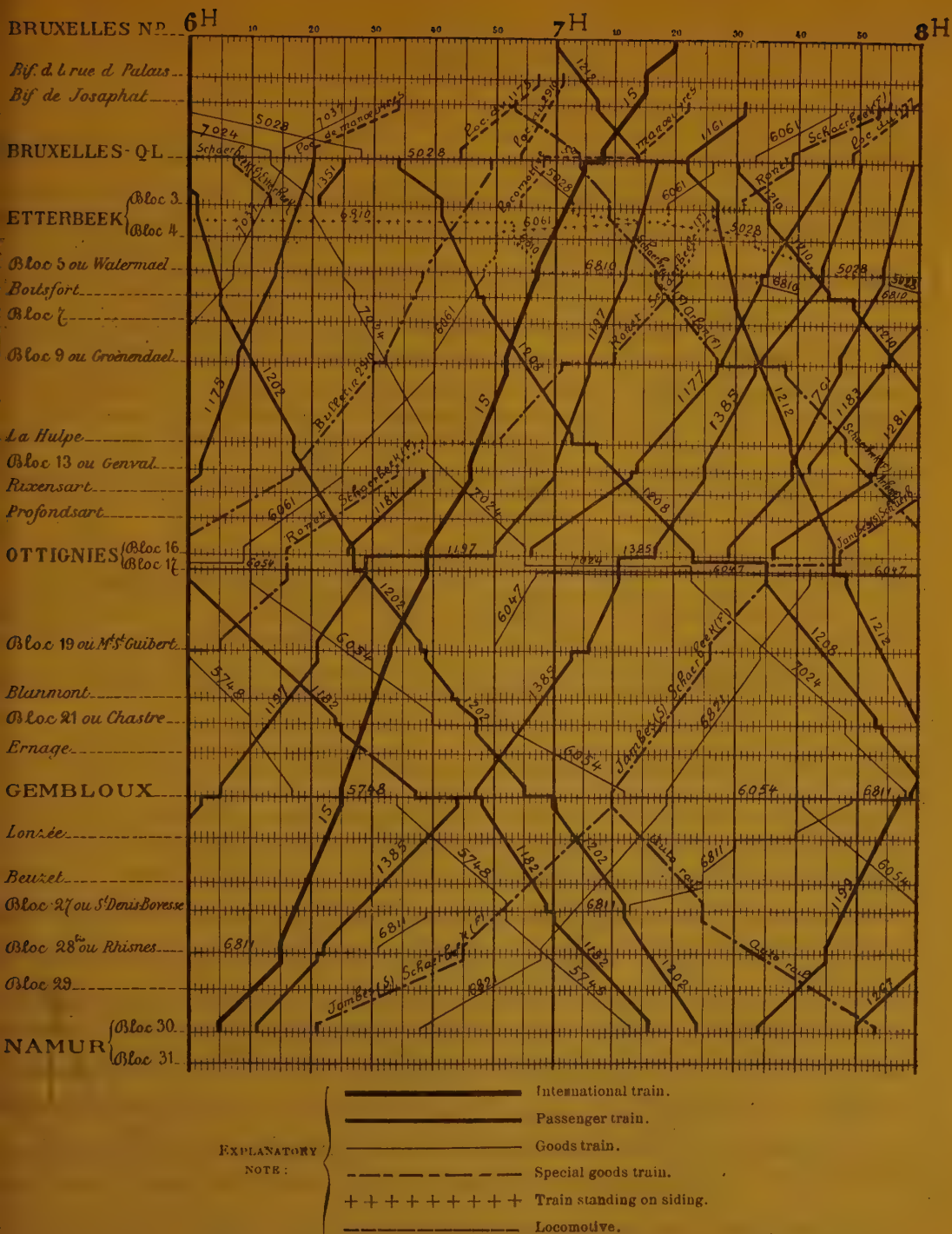


Fig. 18. — Actual graphical diagram plotted by the "dispatcher" (both directions of running combined).

Explanation of French terms: Bif. d. l. rue d. Palais = Rue du Palais junction. — Bif. de Josaphat = Josaphat junction. — Bloc 5 ou Watermael = Block 5 or Watermael. — Bloc 9 ou Groenendael = Block 9 or Groenendael. — Bloc 19 ou M^{ts} Guibert. — Block 19 or Mt. St. Guibert. — Bloc 21 ou Chastre = Block 21 or Chastre. — Bloc 27 ou S^t Denis-Bovesse = Block 27 or St. Denis-Bovesse. — Bloc 28 ou Rhisnes = Block 28 or Rhisnes.

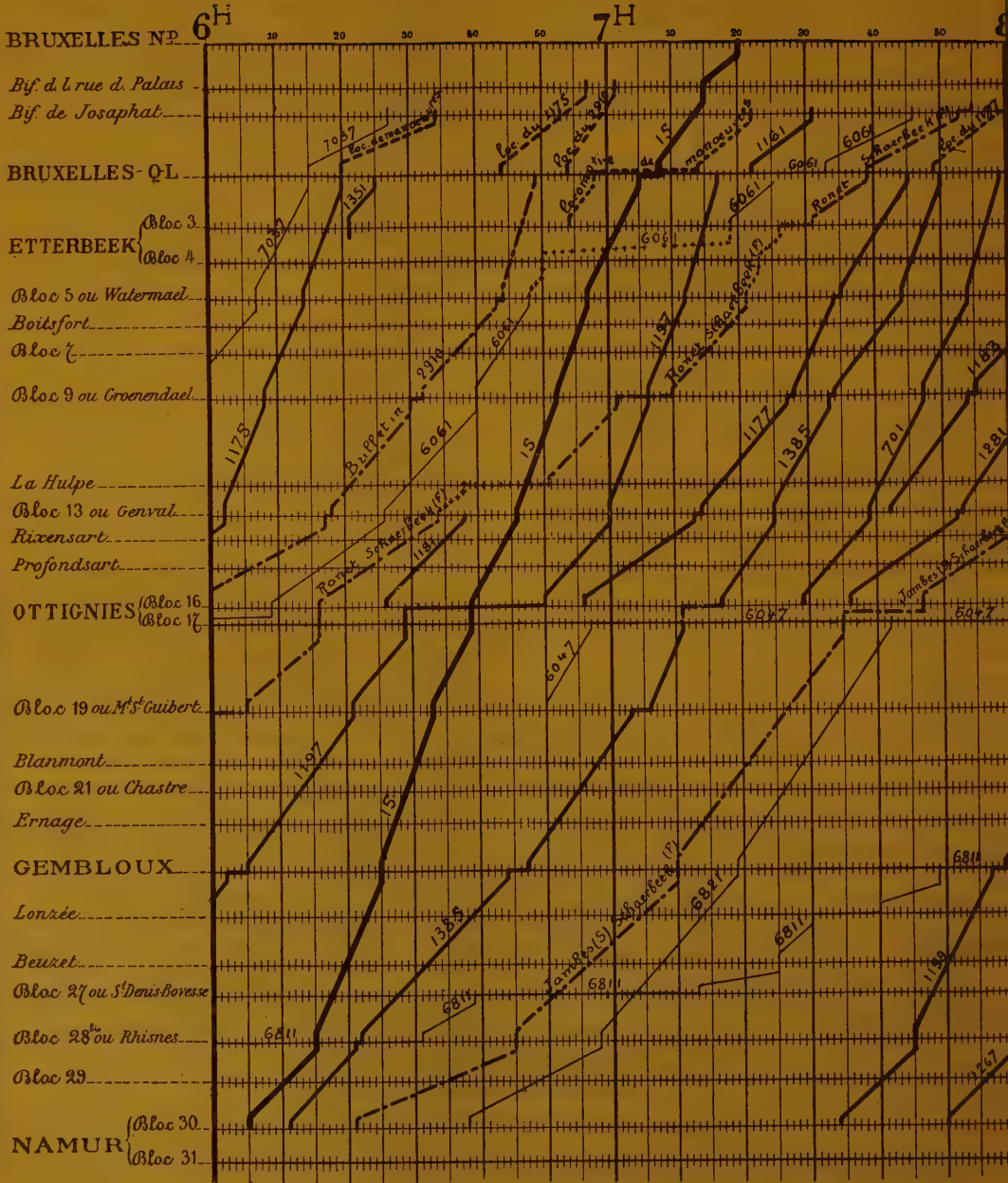


Fig. 19. — Excerpt from actual graphical diagram plotted by the " dispatcher " (traffic from Namur to Brussels)

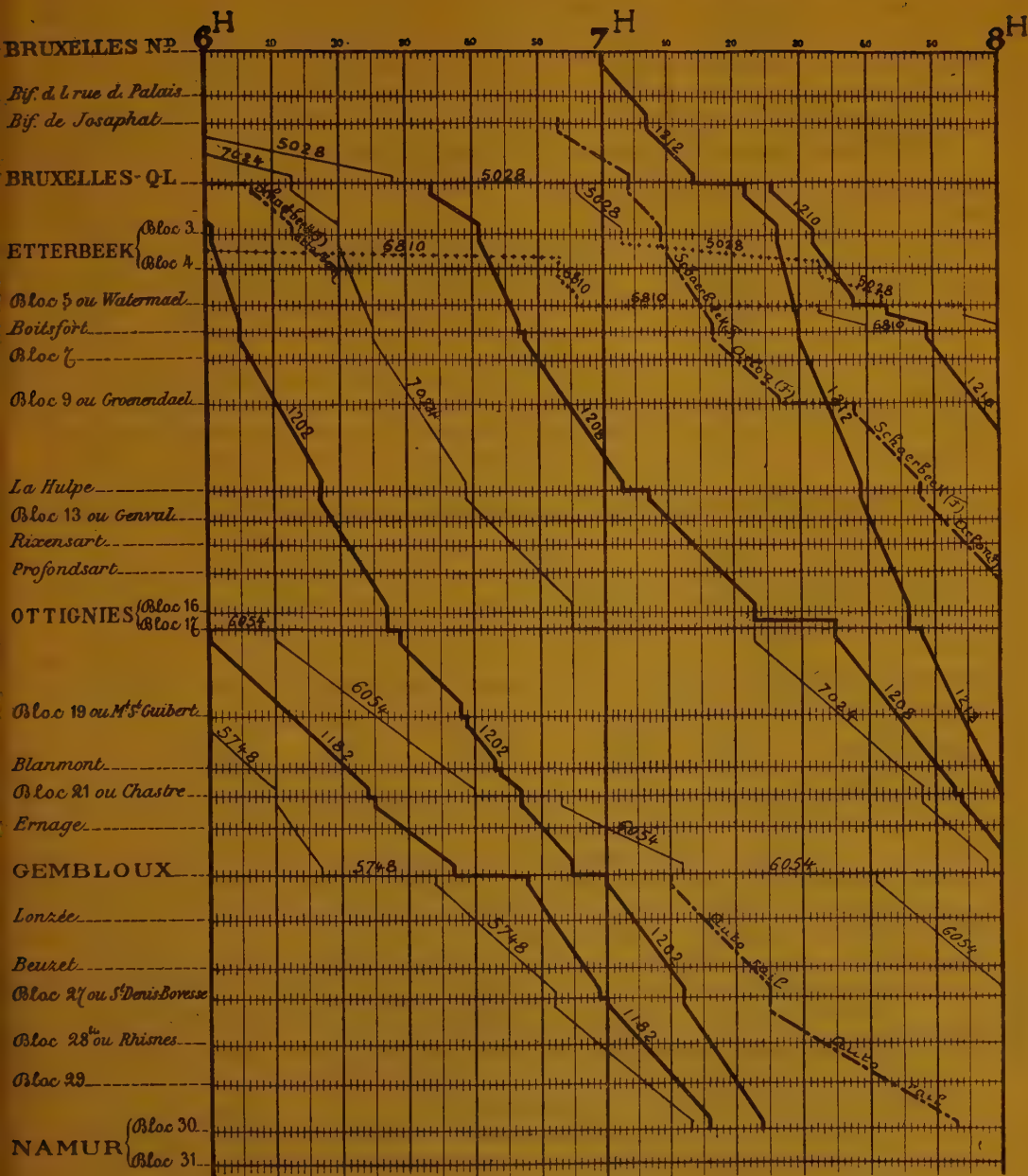


Fig. 30. — Excerpt from actual graphical diagram plotted by the "dispatcher" (traffic from Brussels to Namur).

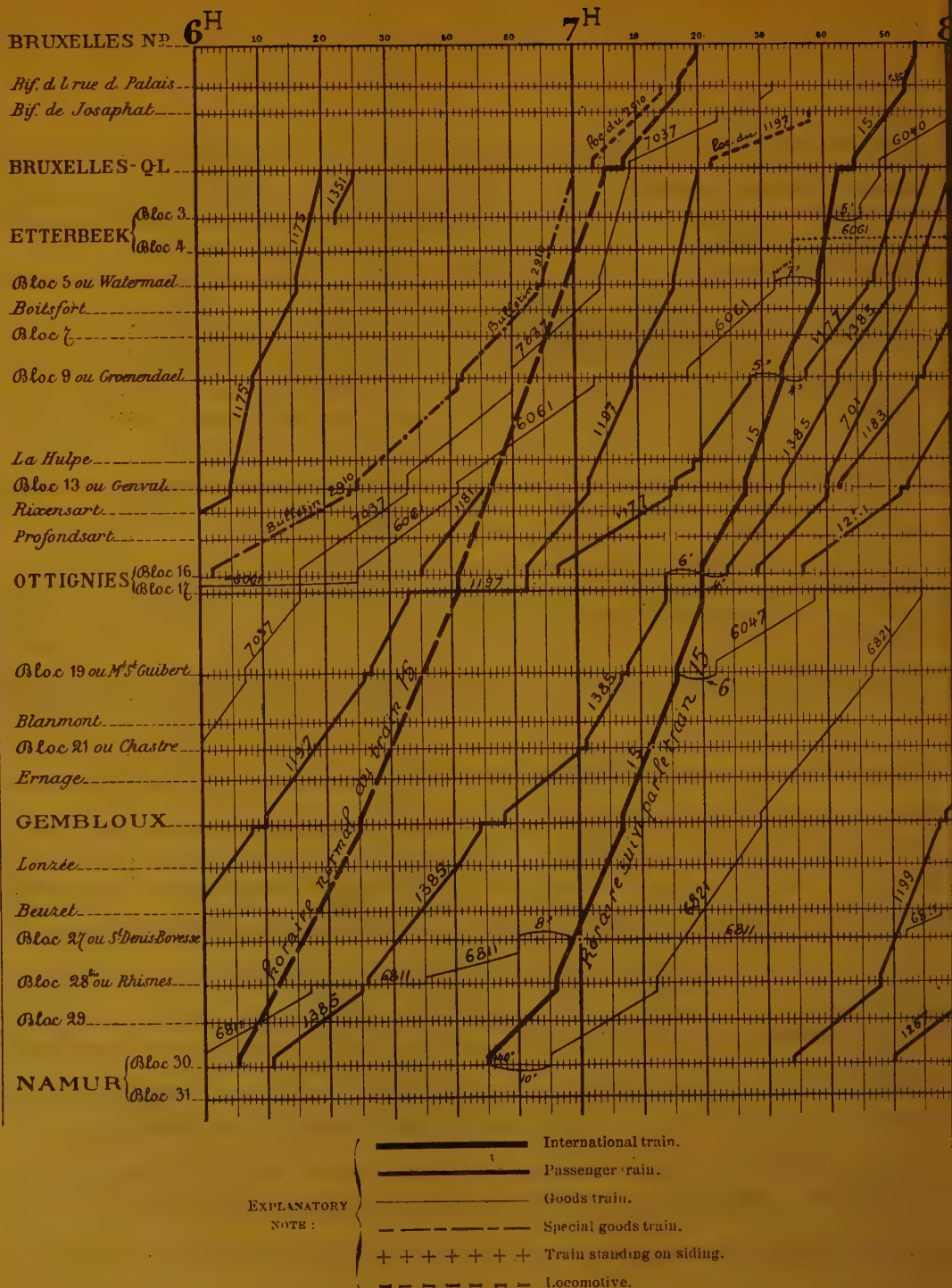


Fig. 21. — Excerpt from actual graphical diagram plotted by the " dispatcher ", showing the vigilance of the " dispatcher " in dealing with the lateness of the international train No. 15.

To take *another example* from a thousand, on 29 March last the through train No. 15 was given on at Namur to the « dispatcher's » section 40 minutes late as shown in figure 21.

This train being out of its regular time had to run over the line between 7 and 8 a. m., that is to say at the busiest time of the day.

Trains Nos. 6841, 1385, 1177 and 6061 had to be put in sidings to clear the road. This shows the vigilance of the « dispatcher ». All these trains were run to the furthest siding, and actually :

train 6841 avoided train 15 by an interval of 8 minutes,

train 1385 by an interval of 6 minutes,

train 1177 by an interval of 5 minutes and

train 6061 by an interval of 7 minutes,

that is to say at the interval of the block. The stations asked to be allowed to put these trains in the sidings much earlier, but the « dispatcher », knowing exactly how the through train was running, delayed the operation to the last possible moment.

As soon as train No. 15 had passed, the « dispatcher » sent off in succession behind it the trains that had been put into sidings :

train 6821 followed train No. 15 after 8 minutes interval,

train 6047 after 6 minutes interval,

train 1385 after 4 minutes interval,

train 1177 after 4 minutes interval, and

train 6040 after 5 minutes interval.

The time during which the trains occupied the sidings was therefore reduced to the minimum.

Moreover, train No. 15 itself was not delayed at any moment of its run, on the other hand, it came out of the section less late than when it entered it.

Telephone organization.

The telephone organization comprises two circuits with selectors (see fig. 22).

1. — *The main circuit* consists of an independent and direct telephone line which connects *continuously the telephone stations having night service.*

For stations which have no night service, the station by day and the block signal cabin by night are alternatively connected to the main circuit according to the position of the switch.

For all the stations or cabins above, the « dispatcher » is constantly listening-in, and in order to speak to him an operator on the line unhooks his receiver, presses on the lever or push, gives his name and speaks ⁽¹⁾.

For certain *subsidiary stations*, the central office has not a calling key enabling the « dispatcher » to connect to them, but these cabins have, like the others, special telephone apparatus which enables them to get on to the selector line and to speak to the « dispatcher ».

Finally, in consequence of the amount of work to be done on the section in question, it has been found necessary to arrange a *secondary circuit fitted with selectors*, apart from the main circuit, connecting with some cabins to the north-west of Brussels (see fig. 22).

These telephone stations are not situated on the trial section, their functions are to signal to the « dispatcher » the trains which will enter his section, and they are in reality only *feelers extending* to the adjacent lines.

The station employees cannot use the telephonic circuit with selectors to talk to each other; this circuit is kept exclusively

(1) Normally the transmitter is not in circuit, the receiver alone being connected; pressing on the lever or push puts the transmitter into circuit.



Fig. 22. — Telephonic "dispatching" circuits of the line from Brussels Northern to Namur.

(See explanation of the French terms on opposite page.)

for exchanges of messages with the « dispatcher » relating to the running of the trains.

In this first trial in consequence of the large number of announcements of trains received by the « dispatcher », and although the principle had been adopted, the *locomotive sheds* could not be introduced on the main circuit.

To get into communication with the running sheds, the « dispatcher » uses the direct telephone lines (see fig. 22) which enable him to get into touch with the sheds at Brussels (Nord), Schaerbeek, Laeken, Ronet, Namur, Tamines, Jemelle and Arlon.

Finally, apart from the selector circuits, the « dispatcher » has direct telephonic communication with the « standards » at the principal stations which enables him to communicate with the stations on the lines connected to them.

Method employed for telephonic communications.

Messages must be given in the briefest form.

The cabin or station must commence by giving its name, and then waiting till the « dispatcher » asks him to speak.

Examples :

The station-master at La Hulpe has a communication to make, he calls : « This is La Hulpe ».

The « dispatcher » replies : « La Hulpe speak ».

La Hulpe gives its message : « Train 1256 passed La Hulpe at 15 h. 50 (3.50 p. m.), what news of 1235? » or, for instance : « 6809 arrived La Hulpe 16 h. 2, going on siding for 1291. »

The « dispatcher » repeats : « 1256 passed La Hulpe 15 h. 50. »

He gives information : « 1235 15 minutes late at Rhisnes. »

He advises : « 6809 arrived La Hulpe 16 h. 2 (4.02 p. m.) If it is ready before 16 h. 20 send it to siding at Groenendael because 1291 is delayed between Mont-Saint-Guibert and Ottignies. »

La Hulpe finishes the communication by the word « finished ».

The « dispatcher » repeats « finished ».

In case of absolute urgency a cabin can interrupt a communication that is taking place by calling its name and saying « urgent ». For example : « This is Mont-Saint-Guibert, urgent. »

Instructions given to the stations.

Station-masters must make the necessary arrangements in order that replies shall be given at once to any call from the « dispatcher ».

All telephone stations (except auxiliary cabins) must announce without waste of time, to the « dispatcher », the times of arrival and departure or of running

Explanation of French terms of figure 22. — Légende = Explanatory note. — Circuit du « Dispatching » Ligne de Bruxelles-Nord à Jambes (Secours) = « Dispatching » circuit Brussels Nord to Jambes (auxiliary). — Circuit du « Dispatching » (Quadrilatère) = « Dispatching » circuit (quadrilateral). — Circuits ordinaires reliant le « Dispatching » aux stations importantes = Ordinary circuits connecting the « dispatching system » to important stations. — Circuits ordinaires reliant le « Dispatching » aux remises aux locomotives = Ordinary circuits connecting the « dispatching system » to the locomotive sheds. — Postes de la ligne du « Dispatching » avec clé d'appel au bureau central = Telephone stations on the lines equipped with the « dispatching system » having a call-key for the central office. — Postes de la ligne du « Dispatching » munis de commutateurs = Telephone stations of the « dispatching » line fitted with commutators. — Postes de la ligne du « Dispatching » n'ayant pas de clé d'appel au bureau central = Telephone stations of the « dispatching » line not fitted with a call-key for the central office. — Remises aux locomotives = Locomotive sheds. — Standards des stations importantes = Standards at important stations. — Cabine = Cabin. — Bif de = Junction for. — Bloc = Block signal cabin. — Vers = To. — Poste nord de garde excentrique de St. Denis-Bovesse = Northern cabin of switchman of St. Denis-Bovesse.

through of all traffic; the changes which they make in the order of running of the trains (putting on sidings, taking off); shunting operations and special operations which will delay a train; difficulties of a train, apparatus out of order and, generally all those troubles which may interfere with the regular running of the trains.

The station-master receiving a train having shunting operations to perform or to go on to a siding, must, before commencing these operations, announce the arrival of the train to the « dispatcher » in order to obtain from him the latest particulars.

§ 3. — How does the « dispatching » system of the Belgian State Railways differ from the French « dispatching » system.

On the Belgian State Railways the « dispatcher » takes the place of the delivery of the telegraph message in announcing to the stations the delays, passing and cancelling of regular trains, the starting and the cancelling of optional or special trains, the insertion of special trains into the traffic, a reform which the French have not attempted up to the present.

The Belgian « dispatcher » has greater powers vested in him.

In Belgium the liaison between the locomotive sheds and the « dispatching » service is much closer than in France. Thus the Belgian « dispatcher » is concerned with the use of the stand-by locomotives and can suggest the transfer of the locomotive hauling a train from one shed location to another to relieve one that may be temporarily in need. The Belgian « dispatcher » may also, by arrangement with the running department, modify the service of the locomotives running on the line worked by « dis-

patching », provided that they return to the depot within the limit of mileage permitted and that they perform an equivalent service.

The Belgian « dispatcher » also keeps himself constantly in touch with the number and destination of the wagons to be taken off at the stations and arranges for taking them off according to custom, or to the possibility of receiving them at call stations on the route, or at their destination.

When difficult circumstances arise, he modifies the normal route of the loaded or empty wagons and has them detached at a call station where the traffic is less disturbed.

The Belgian « dispatcher » acts as intermediary between the office that distributes the wagons and the stations for transmitting orders relating to the distribution of the wagons.

He refers to other stations the carrying out of orders to send on rolling stock which a station on the line is incapable of performing; he also sends to another station which can utilize it, or to the proper place for concentrating it, the rolling stock that has been requisitioned by a station; but is no longer required owing to the unforeseen arrival or setting free of rolling stock. In exigencies the Belgian « dispatcher » makes temporary change in the direction of movement of empty rolling stock.

Finally, the Belgian « dispatcher » can permit a goods train to run ahead of its time-table (he is not even required to make this train follow the official time-table in place of a later train) which is quite different to the function of the French « dispatcher » who is kept rigidly to the time-table for goods trains. The Belgian « dispatcher » is also allowed to eliminate stops that had been arranged in the time-table of a goods train if these

should be unnecessary. The running of slow trains consequently suffers much less from the delay of express trains.

S 4. — Description of the telephonic selector apparatus.

The telephone system in use on the Belgian State Railways is of the type designed by the « Western Electric Company » of America, whose representatives in Belgium are the « Bell Telephone Manufacturing Company » of Antwerp. The method of working is as follows :

A two-wire telephone line serves all the stations and signal-cabins of the section worked by « dispatching » (fig. 23).

Each of these telephone stations or cabins on the line is arranged with a shunt circuit. The office of the « dispatcher », or the main cabin or station, may occupy any position along the line.

The « dispatcher » carries a microphone chest-transmitter and wears a receiver with head-band (figs. 24 and 25); he listens-in continuously on the common line. It is therefore sufficient if an employee at any station goes to the telephone for him to get immediately into touch with the « dispatcher », that is to say — and this is important — without having to call him up.

If the « dispatcher » on his part wishes to transmit an order to any particular station, he calls this up by means of a special appliance called the « selector key » (figs. 26 and 27) which is independent of the telephone apparatus properly so called.

The « dispatcher » is provided with a special key for each station.

All the selector keys are arranged in a box placed on the « dispatcher's » table and are thus within reach of his hand (fig. 28).

By turning the key for the station re-

quired, the « dispatcher » sends over the line a pre-arranged combination of electric currents which set in action special receiving appliances known as « selectors » fitted at all the telephone stations and each connected with a call bell; but only that selector which is so made as to correspond to the particular combination of currents can continue its movement far enough to close the call bell circuit. The other selectors which are not arranged for the particular combination are returned to zero without having effected the closing of the call bell circuit.

Figures 29 and 30 show diagrammatically the general arrangements of the central telephone apparatus and of the telephone apparatus on the line.

1. — Central telephone. Call apparatus.

a) *Function of the selector key.* — The function of the selector key is to send along the line currents that are alternately positive and negative and to make them follow in a definite rhythm, a rhythm which is different for each key and to which alone answers the selector for the line arranged to receive this particular rhythm.

b) *Description and working of the selector key.* — When the « dispatcher » turns the selector key (see figs. 26 and 27) he winds up a clockwork mechanism (one quarter turn of the key suffices to effect the winding of the spring). On releasing the key the spring releases the clockwork which turns a toothed wheel *D* (fig. 29). For one quarter turn of the key, that is to say for a call, the toothed wheel makes one complete revolution (figs. 31 and 32). Stops limit the movement of the key and of the wheel.

The wheel *D*, which carries teeth on only a portion of its circumference, has a

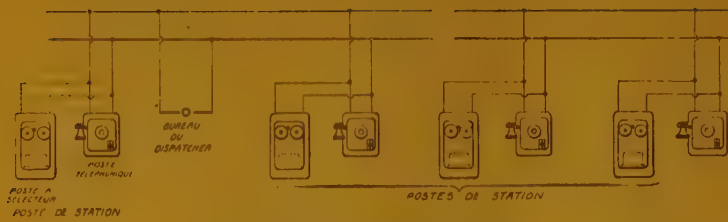


Fig. 23. — Station apparatus.

Explanation of French terms : Poste de station = Apparatus at station. — Poste à sélecteur = Selector Instrument. — Poste téléphonique = Telephone instrument. — Bureau du dispatcher = "Dispatcher's office". — Postes de station = Station appliances.



Fig. 24. — Microphone chest transmitter with mouth-piece and receiver with head-band for main office.



Fig. 25. — Central office worked by two "dispatchers".

notch cut in at the zero position, between two portions without teeth; it also has a portion in which the teeth have not been cut or a circular cam.



Fig. 26.



Fig. 27.

Figs. 26 and 27. — Call-key.



Fig. 28. — Box arranged with twenty-four selector keys.

Finally, two movable sectors s^1 and s^2 are carried on this wheel; s^1 is a flat sector back. and the other, s^2 , is generally curved

As will be seen from figures 31 and 32, the external circumference of the flat sector s^1 is equal to the external circumference of the wheel teeth, but the external

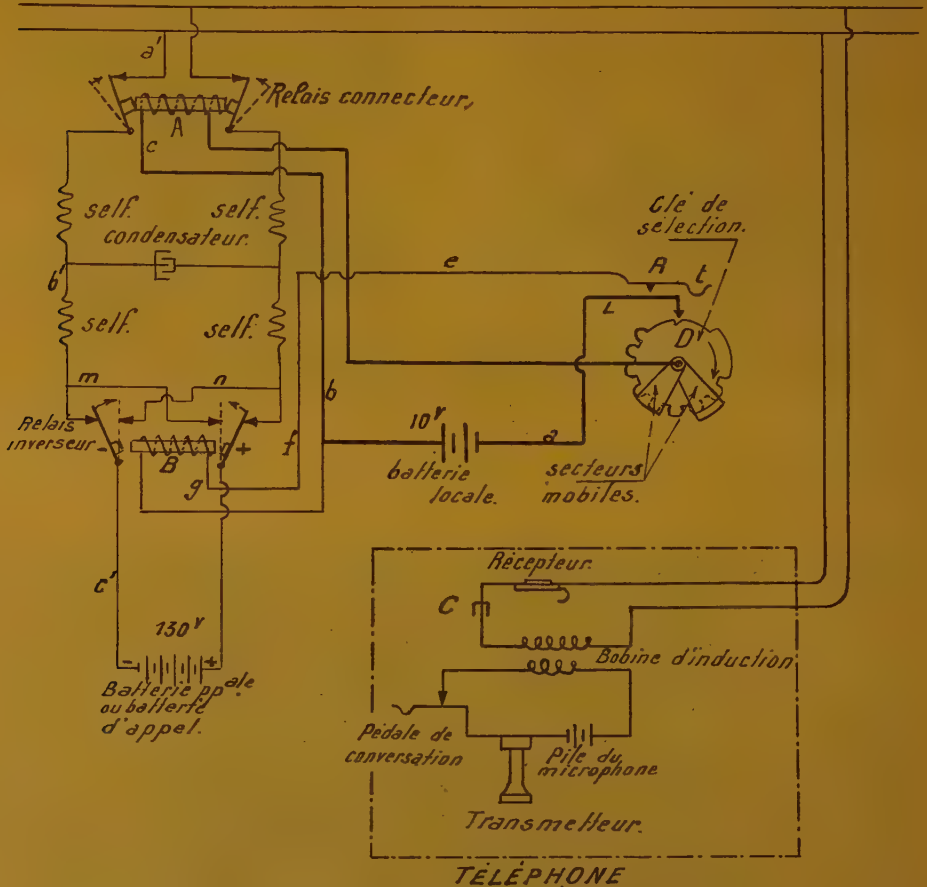


Fig. 29. — Diagram of "dispatcher's" apparatus.

Explanation of French terms : Relais connecteur = Connector relay. — Self. = Self-induction coil. — Condensateur = Condenser. — Clé de sélection = Selector key. — Relais inverseur = Reversing relay. — Batterie locale = Local battery. — Secteurs mobiles = Movable sectors. — Batterie ppale ou batterie d'appel = Main battery or call-battery. — Récepteur = Receiver. — Bobine d'induction = Induction coil. — Pédale de conversation = Conversation treadle. — Pile du microphone = Microphone battery. — Transmetteur = Transmitter. — Téléphone = Telephone.

circumference of the curved sector s^2 , is rather greater and does not lie in the same plane.

At rest, the flexible blade L engages

with the zero notch of the toothed wheel D of the selector key (figs. 32 and 29) but without touching the wheel. Under these conditions, the circuit a, b, c of the local

battery ⁽¹⁾ and of the connecting relay *A* remains open (fig. 29).

two armatures of the relay *A* are attracted to their contacts as is shown in solid lines. At the same time the line circuit is closed through *a' b' c'* and the principal battery (130 volts) which sends the calling up current along the line (continuous current).

The circuit *a' b' c'* remains closed until, the wheel having completed its revolution, the blade *L* has returned into the zero notch and does not make contact with the wheel.

Under normal conditions the line does not carry current; the use of the connecting relay is to connect the main battery only to the line during the complete revolution of the key.

While the wheel revolves, the blade *L* is alternately raised and lowered at different intervals (figs. 33 and 34); it is raised when it passes over a tooth (fig. 33), or over the flat sector *s*¹ or over the circular cam (but the blade *L* is not wide enough to be moved by the curved sector which lies in another plane); it is lowered when it passes into a space between teeth or on the two toothless portions of the wheel (fig. 34).

Each time it is raised it makes contact with a contact spring *R* which acts by closing the circuit *efg* of the local battery with the relay *B* (fig. 29); this is excited, its armatures are thrown over (dotted position), and change the direction of the current sent from the main battery through the connections *mn* along the line during the time that *L* and *R* are in contact; the currents sent are therefore alternately positive and negative. When the contact is broken, the relay *B* is no longer excited, the armatures return to their normal position and the current flows in the original direction.

If it is supposed for a moment that the two sectors are removed from the toothed wheel the passage of the blade *L* over

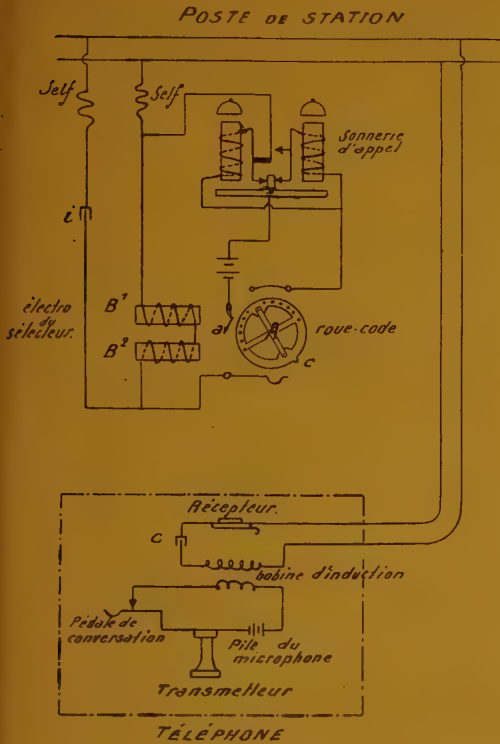


Fig. 30. — Diagram of station apparatus.

Explanation of French terms: Poste de station = Station apparatus. — Self. = Self-induction coil. — Sonnerie d'appel = Call-bell. — Electro du sélecteur = Electro-magnet of selector. — Roue-code = Code-wheel. — Récepteur = Receiver. — Bobine d'induction = Induction coil. — Pédale de conversation. — Conversation treadle. — Pile du microphone = Microphone battery. — Transmetteur = Transmitter. — Téléphone = Telephone.

When the « dispatcher » turns the key, the wheel *D* is driven, the blade *L* rubs on the first cylindrical portion of the wheel, the circuit *abc* is closed and the

(¹) Generally 10 volts, but at Brussels (Nord) the 25-volt battery of the electric signalling cabin is used.

each of the teeth will produce two changes of direction of the current sent by the call battery along the line, the number of reversals of direction of the current will

therefore be double that of the number of teeth.

Actually, during the travel from the top of the first tooth to the bottom of the

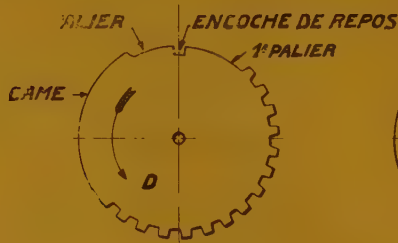


Fig. 31.
Selector-wheel.

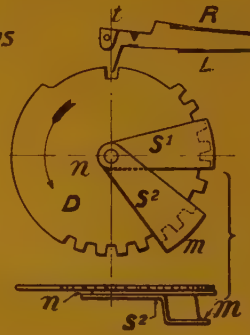


Fig. 32.
Selector-wheel with sectors.

Explanation of French terms : Came = Circular cam. — 2° Palier = Second cylindrical bearing. — Encoche de repos = Zero notch. — 1° Palier = First cylindrical bearing.

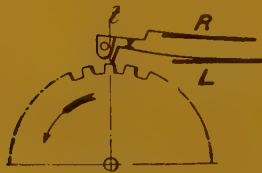


Fig. 33.



Fig. 34.

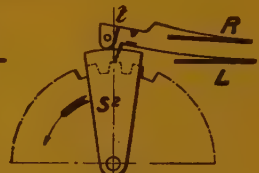


Fig. 35.

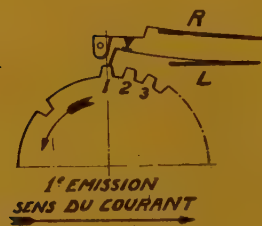


Fig. 36.

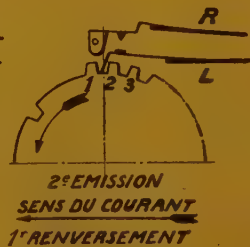


Fig. 37.

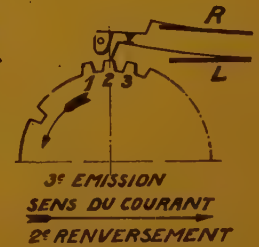


Fig. 38.

Explanation of French terms : 1° Emission sens de courant = 1st flow, direction of current. — 2° Emission, sens du courant, 1^{er} Renversement = 2nd flow, direction of current, 1st reversal. — 3° Emission, sens du courant, 2^e Renversement = 3rd flow, direction of current, 2nd reversal.

gap following it (figs. 36 to 38) there is a reversal (releasing of *L* and *R*), and dur-

ing the travel from the bottom of this gap to the top of the second tooth, there

is another reversal (contact between *L* and *R*) and so on.

In the succession of currents sent that are produced during a revolution of the toothed wheel, it will be seen that starting from the zero notch the first current will be sent when a tooth comes into action and as the second current (in the opposite direction) is produced when passing over the first gap it follows that any passage *over a tooth* will correspond to an impulse of *odd* number, and any passage into a gap to a current of *even* number.

The function of each of the sectors is to eliminate a definite number of reversals of current during the complete revolution of the wheel.

So long as the blade *L* does not come into contact with the toothless portion of the wheel or the cam or the sector its passing over the teeth and into the gaps has the effect of sending over the line by the call battery a continuous series of impulses which is generally known as the *train of impulses*. As there are two sectors each of which produces two intervals in a succession of reversals of current, it is possible to have three trains of impulses for a complete revolution of the tooth-

ed wheel; in other words each call comprises three trains of impulses.

Moreover, for all the pieces of apparatus on the section in charge of the same « dispatcher », the *total* number of alternating impulses sent along the line remains constant, and in this case is equal to 17.

It will be understood that although there is only a single type of toothed wheel, of flat sector and of curved sector, it is only necessary to vary the setting of the two sectors on the wheel in order to modify the number of impulses that make up each of the three successive trains of impulses which, in combination, produce the call.

This comes back to saying that the impulses are sent on the line in a certain rhythm, for example, figures 39 and 40 :

1 st train. . . .	12 impulses; pause.
2 nd —	3 — —
3 rd —	2 —
Total. . .	17 impulses.

1 st train. . . .	6 impulses; pause.
2 nd —	4 — —
3 rd —	7 —
Total. . .	17 impulses.



Fig. 39.

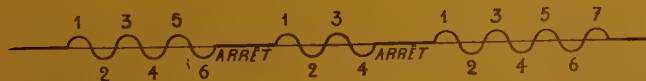


Fig. 40.

Figs. 39 and 40. — Trains of impulses.

Explanation of French term : Arrêt = Pause.

It is only by this position of the sectors that the calling keys of the different stations or cabins can be differentiated from each other.

In this manner a certain number of

combinations are obtained which determine how many stations can be served on the same line. With the system of keys giving 17 impulses the number of these combinations is 78, provided that a

train consists of at least two impulses. The « dispatcher » can consequently correspond, if required, with 78 stations or cabins on the line (the line from Brussels to Namur has 23). Another type of apparatus with 27 impulses enables this number to be increased to 253.

Table 3 below gives the various combinations used for the 17-impulse system:

TABLE 3.

Total number of impulses : 17. Combinations possible : 78.				
A train of impulses consists of at least 2 impulses.				
2-2-13	3-2-12	4-2-11	5-2-10	6-2-9
2-3-12	3-3-11	4-3-10	5-3-9	6-3-8
2-4-11	3-4-10	4-4-9	5-4-8	6-4-7
2-5-10	3-5-9	4-5-8	5-5-7	6-5-6
2-6-9	3-6-8	4-6-7	5-6-6	6-6-5
2-7-8	3-7-7	4-7-6	5-7-5	6-7-4
2-8-7	3-8-6	4-8-5	5-8-4	6-8-3
2-9-6	3-9-5	4-9-4	5-9-3	6-9-2
2-10-5	3-10-4	4-10-3	5-10-2	...
2-11-4	3-11-3	4-11-2	...	...
2-12-3	3-12-2	...	...	...
2-13-2	...	...	...	...
7-2-8	8-2-7	9-2-6	10-2-5	11-2-4
7-3-7	8-3-6	9-3-5	10-3-4	11-3-3
7-4-6	8-4-5	9-4-4	10-4-3	11-4-2
7-5-5	8-5-4	9-5-3	10-5-2	...
7-6-4	8-6-3	9-6-2	...	12-2-3
7-7-3	8-7-2	...	...	12-3-2
7-8-2	...	...	...	13-2-2

Functions of the sectors. — The object of the sectors is to maintain the reverser relay in position for a certain time after the sending of the preceding train of impulses.

Under these conditions after an odd number of impulses, it will be necessary to keep the reversing relay on the line in its thrown-over position, and for this object the sector s^1 would be used, whereas after an even number of impulses, it would be necessary to keep the reversing relay in normal position, and for that the sector s^2 would be used.

The profile of the *flat sector* is there-

fore arranged so as to keep the contact made between L and R ; with this object the outside of the sector covers a certain number of teeth preventing the blade L , during the time it is passing over it, from dropping again into the gaps between the teeth (fig. 32).

The *curved sector* (figs. 32 and 35) is arranged in such manner that it allows the blade L to continue its movement, but so that it moves away the spring R during the time it is passing; for this purpose the curved back end t of R is itself raised directly by its passing over the curved back end of the sector s^2 .

While the end t is passing over the curved sector s^2 , the contact between L and R therefore remains open, the reversing relay is not excited and consequently the current flows in normal direction along the line (fig. 29).

The time necessary for making a call is that taken by the selector key in making a complete revolution, that is 7 seconds for the system having 17 impulses. The period of time that separates two successive impulses in the same train is about one-tenth of a second; the interval between two successive trains is about one second.

A special arrangement enables the « dispatcher » to hear the call bell in subdued form and thus ascertain that the bell has rung at the station called properly.

Condensers are inserted for reducing the sparks caused by breaking the relay contacts, and *self-induction bobbins* are inserted to soften the effect of sending the call currents which otherwise would cause an unbearable rattling in the receiver of the « dispatcher ».

Moreover, thanks to this precaution it is possible to send current during a conversation without producing a noise that would cause difficulty. It follows that

the « dispatcher » can turn the call key of a second cabin before he has actually completed his conversation with the first cabin.

Conversation treadle.

A switch operated by a treadle actuated by the foot enables the microphone circuit to be closed only for the period of the conversation in order to avoid waste of current.

2. — Station apparatus. The selector.

a) *Function of the selector.* — It would be simple to require that at each station on the line there should also be an official permanently listening-in; but in stations of small and medium importance, this employee would have his time but little occupied. Finally, owing to the eight-hour day this would involve a staff of three employees at each station for the twenty-four hours.

In order to avoid this constant attention of an employee for listening-in at each station the selector comes into play for working the call bell at each station or cabin; but the function of the selector goes still further in the fact that it must choose and call one station or cabin from amongst a number of others, all these stations or cabins being arranged as shunts from the same telephone circuit.

b) *Description and working of the selector.* — Figure 30 shows diagrammatically the general arrangement of a station or cabin apparatus; this comprises :

1° *The telephone apparatus.* — The circuit of the telephone apparatus and of the selector apparatus is shunted on the line.

The selectors have a very high impedance which corresponds, for telephonic frequency, to about one megohm, so that

the telephonic transmissions are always satisfactory;

2° *A selector apparatus* used for ringing the call bell.

This apparatus effects the selection by successive electric impulses on the *step-by-step* system.

The alternatively positive and negative currents sent by the main battery along the line are received at the station at which they arrive by a *polarized* electro-magnet ⁽¹⁾ which forms the part that controls the movements of the selector. Figure 42 which represents the selector, shows the mechanism placed above the windings of the electric-magnet; the armature of the latter will be seen on the

(1) Attention is drawn to the fact that the polarization consists in this : a permanent N. S. magnet

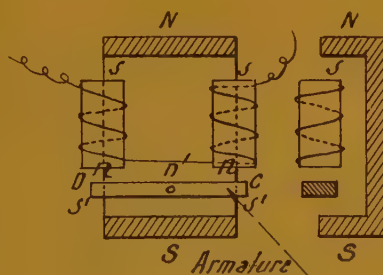


Fig. 41.

surrounding the electro-magnet acts by forming a pole *n'* in the middle of the rocking armature (a north pole under the conditions shown in figure 41), the two ends of the armature taking the opposite polarity. Two poles *n* are similarly formed at the extremities of the cores of the electro-magnet.

In normal conditions the armature is balanced in a position equidistant from the two coils.

When alternating current is sent through the coils, a positive flow strengthens, for example, the magnetism of the north pole *n* of the left core and diminishes the magnetism of the north pole *n* of the right core, the armature is then attracted by the left core. Under the action of negative current, the opposite occurs, causing the armature to rock in the opposite direction.

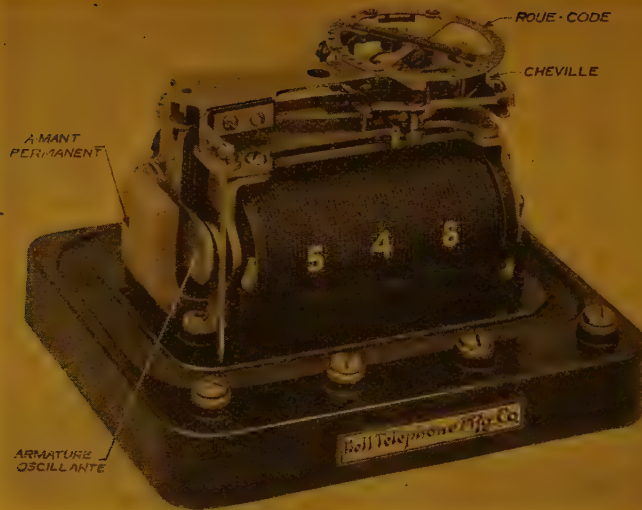


Fig. 42. — Selector.

Explanation of French terms : Aimant permanent = Permanent magnet. — Roue Code = Code-wheel.
Cheville = Pin. — Armature oscillante = Rocking armature.

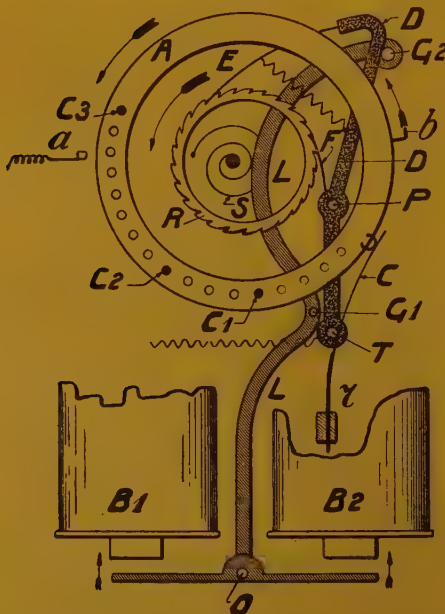


Fig. 43. — Diagrammatic arrangement of selector.

left, as well as the end turned up at right-angles, of the permanent magnet which effects the polarization. The whole arrangement is very compact and is covered by glass (fig. 44).

The two coils B^1B^2 (fig. 43) act on a rocking armature, the axis o of which is placed centrally; according to whether the current sent is positive or negative, the armature rocks in the one direction or in the other and by means of a main lever L , and a train of stop and start ratchets, it sets in movement the ratchet-wheel R , which causes the wheel to advance by one tooth for each movement of the armature. The levers are so arranged that the movement of the ratchet-wheel R always occurs in the same direction, whatever may be the direction of attraction of the armature.

The ratchet-wheel in turning carries with it a light wheel called the *code-wheel* A drilled with holes spaced equidistantly

in which can be placed at various points, three small pins $C^1C^2C^3$. On the photograph (fig. 42), the code-wheel is visible at the upper part of the apparatus.

The positions of the three pins in the code-wheel correspond to the combination call sent by the selector key relating to the station or cabin in question, for example 5-4-8; this spacing varies accordingly for each selector. For the combinations 5-4-8, the first pin is placed in the fifth hole, the second in the $5+4=9^{\text{th}}$ hole, the third in the $5+4+8=17^{\text{th}}$ hole.

A spiral spring S can restore the code-wheel immediately to normal, but the inertia of the ratchet-wheel and of the code-wheel is sufficient to prevent the whole of these two wheels from turning completely back during the interval of one-tenth of a second that occurs between two impulses of the same train.

The main lever L which forms the prolongation of the armature carries two pins G^1G^2 .

When L oscillates, these two pins act alternately on the rocking-lever D , which turns about the fixed point P . Through the ratchets E and F the rocking-lever actuates the ratchet wheel R , keyed to the same spindle as the code-wheel. When the ratchet turns, the code-wheel consequently turns through the same angle.

If the coil B^2 attracts the armature, the main lever L is moved towards the left, the lower pin G^1 moves away from the rocking-lever D but the upper pin G^2 acts on the upper end of the rocking-lever D , the ratchet E causes the ratchet-wheel R to advance by one tooth and consequently the code-wheel also. Immediately afterwards, the retaining ratchet F comes into gear, holding the ratchet wheel in the position into which the first impulse has brought it.

If now, the coil B^1 attracts the arma-

ture, the main lever L rocks to the right, the upper pin G^2 moves away from the main lever but the lower pin G^1 comes into play bearing on the rocking-lever D which causes the ratchet-wheel again to advance by one tooth, taking the code-wheel with it.

The currents sent by the call-key are instantaneous and the armature, having received the impulse, returns immediately to its position of equilibrium, that is to say equidistant from the two coils. After this the ratchets E and F are withdrawn, and the spiral spring S tends to restore the arrangements of the two wheels to normal position. *It is therefore necessary that the succeeding impulse should follow close on the first in order that the system may advance*, otherwise it would have to recommence the movement of advance caused by the first impulse. But, as has been shown, the impulses of the same train follow at intervals of about a tenth of a second, so that the wheel is stopped in its return movement by the second impulse which forces it again to advance.

During the intermediate pause between two trains of impulses, the whole system would automatically return to zero position, if it were not for the following precaution :

Under the effect of the successive impulses that form the first train, the first pin C^1 is brought opposite to the notch C of a stop-spring r , *this spring r is moved away from the code-wheel at each impulse* by the pin T at the end of the rocking-lever D . Moreover, the pin C^1 arrives opposite the stop-notch C at the exact moment at which the first train of impulses is completed. At this moment no current is passing through the electro-magnets, because each train of impulses is followed by a pause of about one second and a

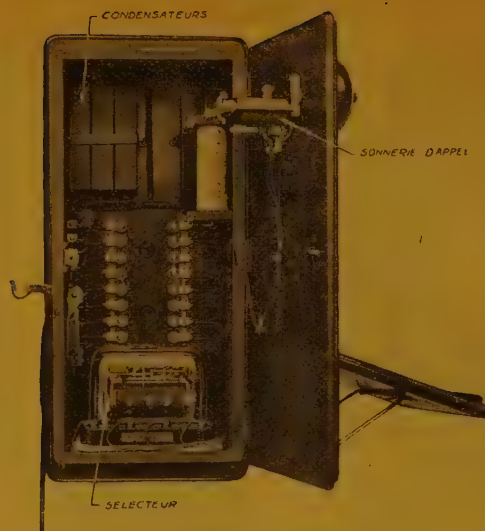


Fig. 44. — Selector apparatus (open).

Explanation of French terms : Condensateur = Condenser.
 Sonnerie d'appel = Call-bell. — Selecteur = Selector.



Fig. 45. — Call-apparatus cabinet.

Explanation of French terms : Protecteur = Protector. — Bobine de self = Self-induction
 coil. — Relais inverseur = Reversing relay.

condenser is put in series with the selector; after this, the stop-notch *C* is left by the rocking-lever *D* which returns to its middle position. As, moreover, the stop-notch is acted on by the spring *r*, it comes against the pin, thus locking the code-wheel and preventing it from returning the whole time of the stoppage.

All the selectors of the line have been similarly set in motion, but only those which contain in their combination the same first train (5 in the example) have been held. All the others have returned to zero because their first pin has passed or has not reached the stop notch.

Under the action of the second train of impulses (4 impulses in the example) the code-wheel again begins to move so as to stop at the second pin *C*². All the selectors having the figure 5 for the first term are moved, but after the second train of impulses, those that are held are only the one that has a pin at the ninth hole ($5 + 4$), as well as those which, having been stopped and returned to zero position after the first train of impulses, have as the first term the figure 4. All the others of which the first two terms of the combination together make figure 9, for example: $7 + 2$, $6 + 3$, etc., have been eliminated during the sending of the first train of impulses, because they did not have a pin at the fifth hole.

Finally, under the action of the third train of impulses (8 impulses in the example) the code-wheel starts again to stop at the third pin *C*³. This is the only

selector which has followed the 17 impulses to the end. At this instant, a contact *b* on the code-wheel makes contact with a fixed contact *a*, which has the effect of closing the call-bell circuit of the cabin or station through the local battery.

The employee at the cabin or station in question, and no other, is thus made aware that the « dispatcher » wishes to speak to him.

Finally, the pins in action are disengaged by an extra impulse which takes place at the moment when the blade *L* leaving the circular cam reaches the first toothless portion (fig. 34). All the selectors then return to the zero position.

By means of the selector apparatus the length of conductor wire necessary for the requirements of the system connecting the various stations or cabins is reduced to a minimum, and loss of time is avoided in making telephonic communication through the intervention of a central telephone board.

Figures 44 and 45 show respectively the selector apparatus (open) and the cabinet containing the call apparatus.

Sending of hourly signals.

The station apparatus enables hourly signals to be sent for *setting the clocks* of the cabins or stations on the circuit. With this object a special key (the hour key), kept at the « dispatcher's » station, enables twenty-two successive impulses to be sent which act on all the selectors on the line (fig. 46).

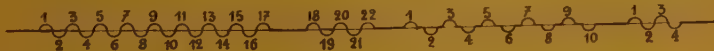


Fig. 46.

At the end of this series of twenty-two impulses all the selectors are held in the position 22 by a special locking mechanism (a sort of small curved incline).

The toothed wheel of this special key comprises, moreover, a supplementary group of teeth which enable a new series of impulses to be sent (1 to 10, for

example) which have the effect of placing the selector in the call position. As these 10 impulses do not follow sufficiently rapidly, the code-wheels return to the position 22 each time that they have caused the bells to ring for an instant. The station or cabin on the line consequently receives 10 successive rings on the bell; at this moment the clock is set to the time conventionally determined (9 o'clock [a. m.] or 21 o'clock [9 p. m.] for example).

Finally, the special key sends a train of at least four impulses; these succeed each other at normal speed, that is to say, rapidly, which enables the code-wheels to pass the locking incline, all the selectors being thus restored to zero position.

Grouped calls.

It is also possible by the addition of an auxiliary pin to obtain group calls for several selected stations and this arrangement is used for sending instructions that concern only a certain number of stations.

§ 5. — Results obtained.

The trial begun on 1 October 1921 has given results which have exceeded the most optimistic forecasts.

In preparing the note as to the economy effected, the last fortnight before the introduction of « dispatching » and the first fortnight after were taken so as to obtain the same traffic conditions.

A) The passenger trains ran regularly to time;

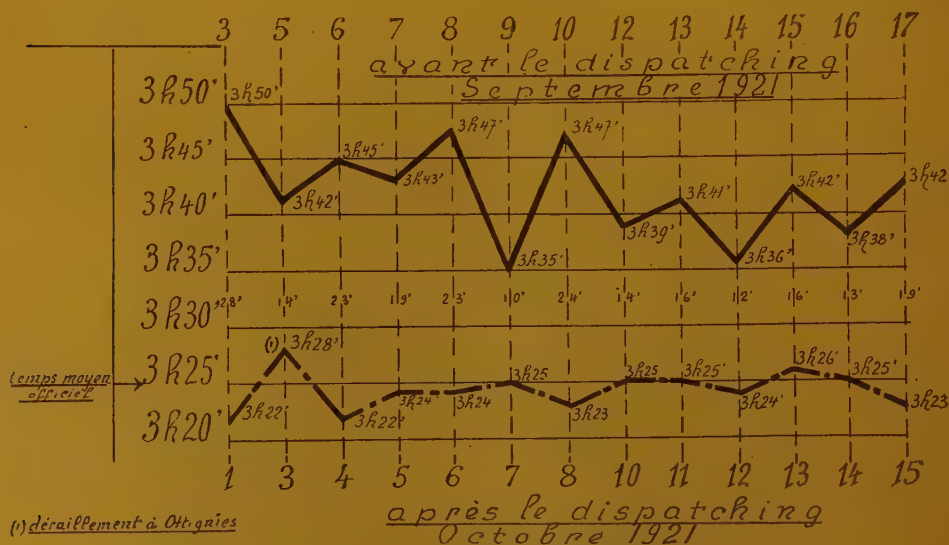


Fig. 47. — Regular goods trains.

Mean time taken for a regular goods train to run the distance from Namur to the Josaphat junction (Brussels). This mean is calculated on the basis of 45 trains per day.

The number of minutes that « dispatching » has saved for each train is : 28' + 14' + ... + 13' + 19' = 231'.

Total saving : $231' \times 45/60 = 173$ hour for 13 days or $\frac{173}{13} = 14$ hours per day.

Explanation of French terms : Avant le dispatching; septembre 1921 = Before « dispatching » was introduced; September 1921. — Temps moyen officiel = Mean official time. — Après le dispatching; Octobre 1921 = After « dispatching » was introduced; October 1921. — Déraillement à Ottignies = Derailment at Ottignies.

B) The goods trains reduced their time allowance for the journey.

With regard to the latter, the regular trains should be examined apart from the special goods trains :

a) *Regular goods trains.* — The graphical diagram (fig. 47) shows that during the period preceding the installation of the « dispatching » system these trains suffered delay and were unable to make up time, whereas during the trial period, the official time allowed for the journey was reduced every day.

The economy obtained in fuel, lubricating material, water and running staff

amounted to 141 000 fr. par annum ⁽¹⁾.

b) *Special goods trains.* — When the actual graphical diagrams of the running of the trains are examined, it will be seen that the running of light locomotives has become exceptional, the « dispatcher » having used for hauling special goods trains those locomotives which should have run back light, and he has thus effected a saving.

Thus it will be seen by examination of the diagram (fig. 48) that, by the satisfactory arrangements they were able to make the « dispatchers » have effected economies during the trial period equivalent to *four locomotives daily* ⁽²⁾.

(1) « Dispatching » by accelerating the arrival of double-headed trains, has caused an economy : in fuel, lubricating materials and water estimated at 11 fr. 20 c. per hour; of wages and bonus to drivers and firemen amounting to 5 fr. 75 c. $\times 2 = 11$ fr. 50 c. on the average per hour; the wages of the guards : 2 fr. 56 c. on the average per hour; the wages of the brakemen (taking four to each train) : 1 fr. 94 c. $\times 4 = 7$ fr. 76 c. on the average each hour; or per annum (11 fr. 20 c. + 11 fr. 50 c. + 2 fr. 56 c. + 7 fr. 76 c.) $\times 14$ hours $\times 305$ working days = 140 995 fr. 40 c.

(2) The number of locomotives which would have been required in addition to haul the special trains during the trial period of the « dispatching » system, if the distance run by the locomotives in use had been the same as during the preceding period : in other words, if the locomotives had only made on the 1, 3, 4 ... of October distances of 56, 74, 62 km., etc., instead of 95, 133, 107 km., ... etc.

October, the.	1 st	3	4	5	6	7	8	10	11	12	13	14	15	Total.	Daily average.
Number of additional locomotives that would have been required.	6 (*)	3	7	3	3.5	6	5	...	2.5	1	7.5	3	5	52.5	$\frac{52.5}{13} = 4.$
Note. — Goods trains do not run on Sundays.															

These four locomotives hauling special trains would have run each day, taking the mean daily distance for the Luxembourg line in September : a distance of 62 km. (39 miles).

This distance corresponds to an expenditure of :

$$4 \times 62 \text{ km.} \times 16 \text{ fr. 50 (**)} = 4\,092 \text{ fr. per day;}$$

or per annum : $4\,092 \times 305 \text{ working days} = 1\,248\,060 \text{ fr.}$

(*) *Example of the calculation.* — On 1 October 1921, the distance for which special trains had to be hauled amounted to 855 km. (531 miles (see table 4); as the distance run per locomotive amounted to 95 km. (59 miles), it would have required $\frac{855}{95} = 9$ locomotives.

If the distance run per locomotive had been that of the corresponding day in September, that is 56 km. (35 miles), there would have been required :

$$\frac{855}{56} = 15 \text{ locomotives.}$$

(**) 16 fr. 50 c. is the cost per locomotive-kilometre or goods trains, including financial charges, on the Luxembourg line.

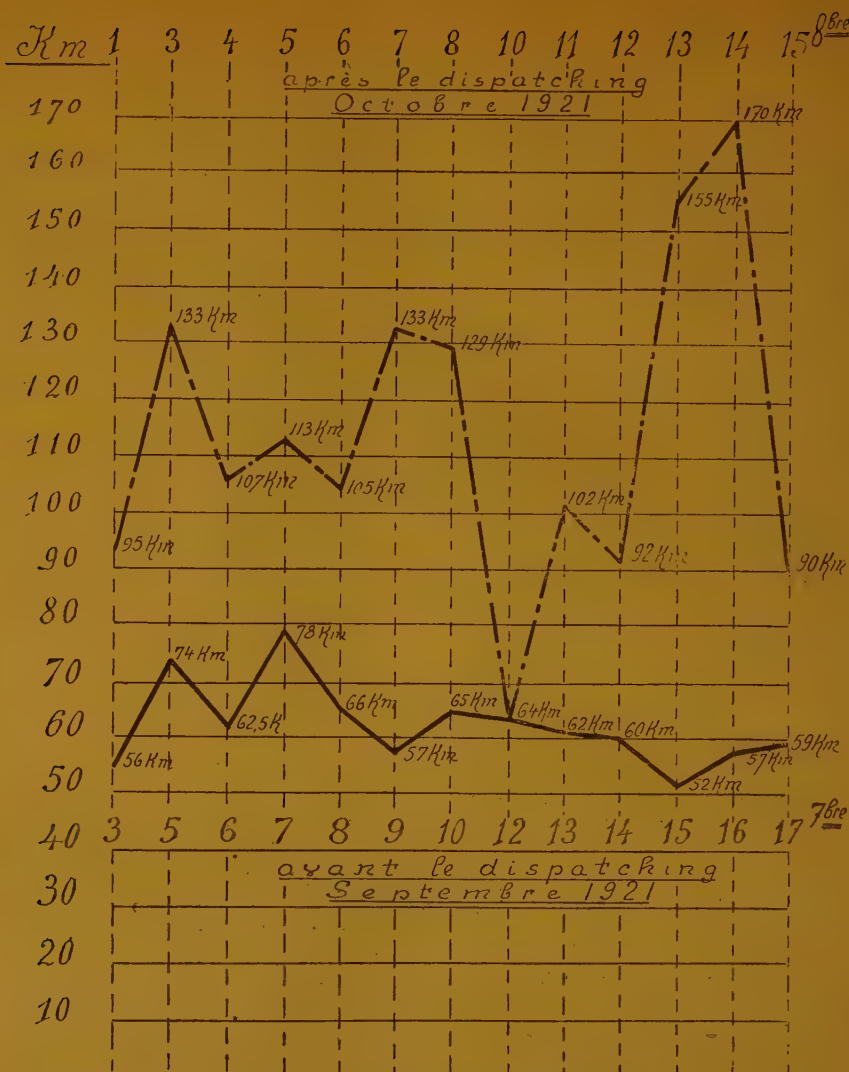


Fig. 48. — Graphical diagram of the mean distance run per eight-hour day by a locomotive hauling a special goods train.

TABLE 4. — Comparison of distances run by locomotives.

Before "dispatching" was introduced; September the	3	5	6	7	8	9	10	12	13	14	15	16	17
Number of locomotives that hauled special trains	22	11	8	9	14	16	11	11	6	8	6	10	10
Number of kilometres run by special trains	1 232	814	500	702	924	912	715	704	372	480	312	570	590
After "dispatching" was introduced; October the	1st	3	4	5	6	7	8	10	11	12	13	14	15
Number of locomotives that hauled special trains	9	4	10	7	6	4	5	2	4	2	4	0	9
Number of kilometres run by special trains	855	532	1 068	790	632	556	649	129	410	185	610	170	815
Mean distance run in kilometres } before. with load by each locomotive. } after .	56 95	74 133	62.5 107	78 113	66 105	57 133	65 129	64 102	62 102	60 92	52 155	57 170	59 90

On the assumption that a similar result would have been obtained over the whole year, the annual economy effected would amount to 1 248 000 fr.

c) *Economy effected by simplifying the telegraph service.* — All the communications received or sent by the «dispatcher» are made by the telephone, whereas formerly they were made by telegraph.

This innovation has reduced the number of service telegrams sent and received by the stations on the Brussels-Namur line; there were 37 012 telegrams per fortnight, a figure which has fallen to 14 456, that is to say there has been a reduction of 60 %. By this means the telegraphic lines have been freed and the sending of private telegrams has improved.

It is evident that an economy in staff corresponds to the reduction in the number of service telegrams, but this saving is difficult to estimate accurately, because in some stations the telegraphists, who are no longer required for the railway, must be retained for the transmission of private telegrams. In any case the actual cost of a service telegram has been fixed by the telegraph administration at 75 c.; it follows from this that the annual saving will amount to (37 012 — 14 456) $\times 0.75 \times 2 \times 12$ months = 406 000 fr.

Total saving :

Saving in fuel, lubrication material, etc., for the regular trains fr.	141 000
Saving due to the better utilization of the locomotives hauling special trains . fr.	1 248 000
Saving resulting from the reduction in the telegraph service fr.	406 000
That is a total of . . fr.	1 795 000

EXPENDITURE.

a) *Cost of the installations.* — The first cost and cost of installing the appliances on the line, for one « dispatching » section, are about 225 000 fr. Taking the rate of interest and amortization at one-tenth of the capital outlay, these charges correspond to an annual amount of 22 500 fr. This sum should be increased each year by 9 000 fr. for cost of maintenance, supply of current and repairs. As the line is 62 km. (39 miles) in length, the expenditure of 225 000 fr. becomes one of 3 630 fr. per km. ⁽¹⁾.

b) *Wages of staff.* — 1° The wages, allowances and official supplement paid to the « chief dispatcher » and to his twelve assistants, amount to 130 000 fr. per annum (10 000 fr. per employee) ⁽¹⁾;

2° In some stations it has been necessary to allocate operators for the « dispatching » service and for the delivery of telephonic messages; (under the regime of telegraphic messages, delivery was effected by the messengers of the telegraph administration). The seven operators on the line involve an annual expenditure of about 30 000 fr.

Summary of annual expenditure :

Cost of amortization of the installation fr.	22 500
Cost of maintenance and renewal fr.	9 000
Cost of staff fr.	160 000
That is a total of . . fr.	191 500

Balance. — Annual saving :

1 795 000 — 191 500 = 1 603 500 fr.
for 62 km. (39 miles) or 25 860 fr. per km.

⁽¹⁾ If, as will be the case in future, the secondary circuit could have been combined with the main circuit the cost per kilometre of track would have been only 3 000 fr. and the staff would have been reduced to eleven employees.

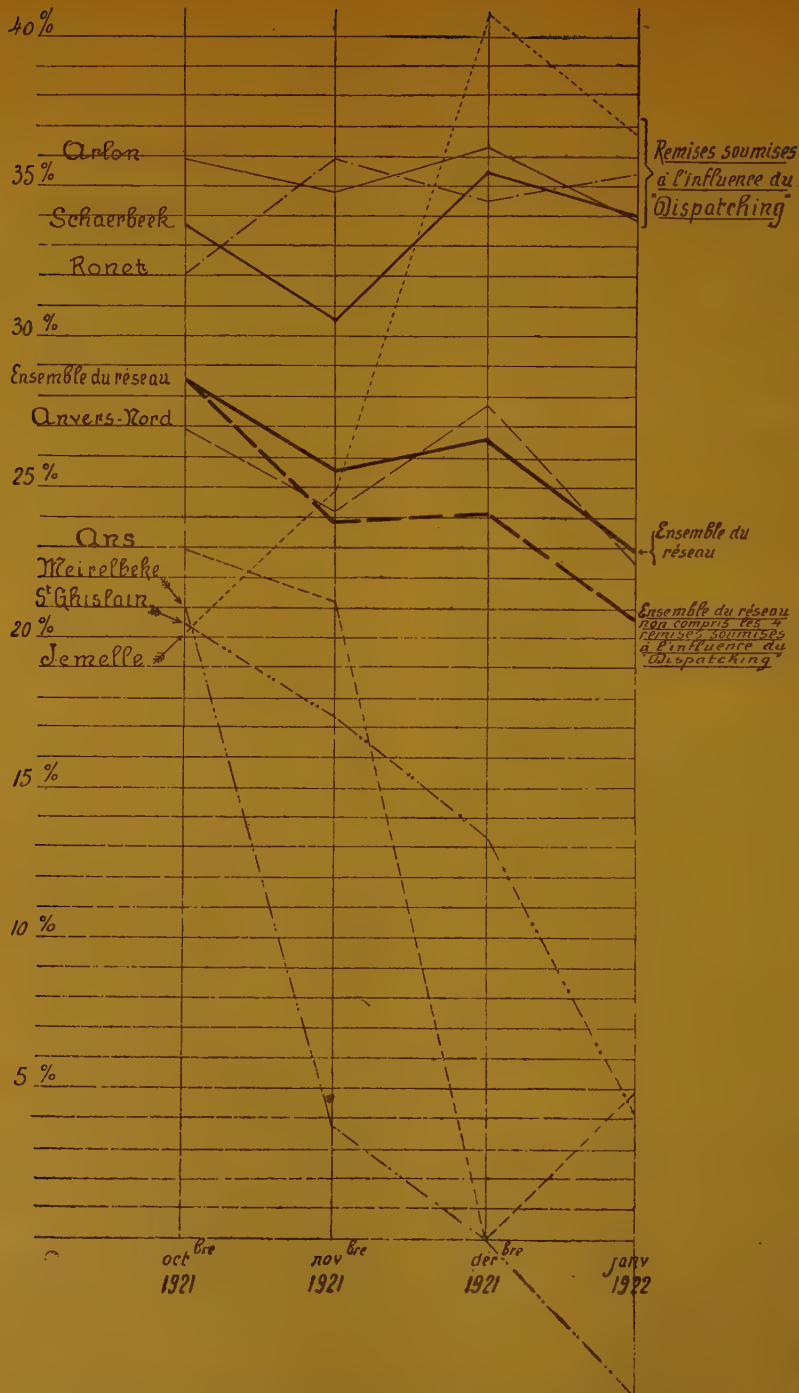


Fig. 49. — Percentage of reduction of fuel consumption per kilometre for the months of October, November, December 1920 and January 1921.

Explanation of French terms : Ensemble du réseau = For the whole system. — Remises soumises à l'influence du « Dispatching » = Sheds controlled by the « dispatching system ». — Ensemble du réseau non compris les 4 remises soumises à l'influence du « Dispatching » = For the whole system (except the four locomotive sheds) worked under the « dispatching system ». — oct^{bre} 1921 = October 1921. — nov^{bre} 1921 = November 1921. — déc^{bre} 1921 = December 1921. — janv. 1922 = January 1922.

It is to be noted that this estimate falls below the actual results. The economy effected in the following fortnight was *five* locomotives. It must, moreover, be remembered that only a portion of the line is in question. The economy would be much greater if the whole of the Luxembourg line was equipped with « dispatching », because, under the present conditions, the section is too short to enable some measures to take their full effect.

Finally, apart from savings which can be expressed in figures, there are also those arising from the more regular running of the trains. It would further be necessary to take into consideration the effect that regular working of the line under « dispatching » exercises on the connecting lines.

The economy of fuel effected on the locomotives due to « dispatching » is worthy of further notice.

In this respect, figure 49 is of particular interest. It will be seen from it that those locomotive sheds of the railway system that come under the influence of the « dispatching system » show a reduction of 30 % to 40 % in the consumption per kilometre for the corresponding month of the previous year.

It will also be seen that the locomotive sheds of Ans, Saint-Ghislain and of Meirelbeke which suffered from the consequences of the difficulties of last winter and which are not influenced by the « dispatching » system show a continual falling off in economy from month to month.

§ 6. — Information obtainable from the trial relating to the apparatus in use on the line and to the office installation.

Fairly frequent troubles occurred in the telephonic circuits of the « dispatching » system; they were invariably caused by the breakage of telegraph or telephone wires carried on the same poles as the bare wires used for the « dispatching system ». These troubles had been foreseen and an arrangement had been made for using an ordinary telephone line as an auxiliary circuit, but this was only a makeshift.

As the Belgian telegraph Administration had not authorized the arranging of the railway telephone lines at the tops of the poles this cause of trouble will be avoided by arranging « dispatching » circuits of *insulated wire* instead of naked wire. The cost of installation will be appreciably increased, and will amount to 4 020 fr. instead of 3 000 fr. *per kilometre of track*.

It had been thought that it would be possible for the « dispatcher » to work with an assistant who would be a mere « operator », but experience has shown that on a line carrying *heavy traffic*, like the Luxembourg line ⁽¹⁾, the functions of the operator were not of less importance. It was consequently recognized to be preferable to replace the operator by a full « dispatcher » and to entrust each of the two « dispatchers » with the management of the traffic in only *one* direction of running. This is what has been done.

(1) Length of the Brussels-Namur section in kilometres (in miles)	62 (39)
Number of regular and special trains (both directions of running taken together)	147
Total number of cabins	23
Number of cabins in actual use	18
Number of communications receive or sent by the « dispatchers » per twenty-four hours	3 050
or 125 communications per hour. It is to be noted that this is the average, consequently at some periods of the day the communications follow more rapidly.	

But under these conditions it becomes unnecessary for the « dispatcher » working on the up line, for example, to hear the telephonic messages intended for his colleague working on the down line; from this arose the idea of making a *separate telephonic circuit for each direction of running*, and, of course, keeping the two « dispatchers » at the same table and facing each other.

This is the *double circuit system* which preferably will be adopted in the future for lines carrying heavy traffic. As the « dispatcher » receives only one-half of the communications, it can be understood that this will relieve the mental strain.

It follows that it will not only be possible to bring the locomotive sheds into the principal circuit, whereas on the single circuit they would have had to be left alone, but that the « dispatcher » has also some little time in which to think out and arrange the most advantageous combinations.

The double circuit will, in particular, enable the whole of the *line from Brussels to Ans* (94 km. [58 miles]) to be worked from one central office.

As, in the case of the double circuit, each station cabin is fitted with two telephones, it is well to fit the apparatus with indicators in order that the station-master may have no hesitation in selecting the apparatus which he must answer; the difference in tone of the bells sometimes leaves a doubt as to which of the two instruments has rung.

Moreover, the indicator warns the station-master on coming into the office that the « dispatcher » has called him.

Nevertheless, in principle the single circuit remains the better solution, the single « dispatcher » having a better grip of the whole circulation on the line. But when the load put upon the single « dis-

patcher » is such that it would be necessary to shorten the section so as to come within the limits of human endurance it is preferable to have recourse to the double circuit which enables a longer section to be worked.

The ideal arrangement is to arrange sufficiently long sections to enable the « dispatcher » to have the train in his field long enough to allow him to correct the running advantageously.

The longer the section the fewer trains pass from section to section and the smaller is the number of central « dispatching offices ». Now a central « dispatching office » involves an annual expenditure of about 110 000 fr. (staff, cost of fitting up, fire, light and maintenance without counting the central apparatus itself).

It is true that the first cost of the double circuit is 7 440 fr. per kilometre of track as against 4 020 fr. for the single circuit (in both cases using insulated wire), but this is a first charge on which the annual charges for interest and amortization are less heavy than the permanent expenses inherent to the establishment of a number of central « dispatching offices ».

There is, however, one case in which the double circuit is not to be recommended and this is that in which each direction of running is not equipped with *its own sidings* and it is necessary to effect a number of operations of putting the trains on sidings by crossing the main tracks. It will be seen that in this case the two « dispatchers » of the double circuit would require to exchange communications too frequently regarding these operations of putting trains into sidings.

This is the case on the *Ans-Herbesthal* line, a sinuous track running through a valley and one on which the sidings are

sometimes on the left and sometimes on the right. The single circuit has, therefore, been adopted in this case.

To sum up, the division of the lines into sections is the result of a compromise between the following desiderata :

- to instal the « dispatchers » in the office of the local traffic manager,
- to make the « dispatching » sections coincide with the boundaries of the local traffic sections,
- to make the « dispatching » sections as long as possible,
- to arrange for one « dispatcher » for each direction of running, whenever the arrangement of sidings allows of this,
- to make the « dispatching » sections overlap the longest distances run by the locomotives.
- not to have the liaison between two « dispatching » sections in a station having very heavy traffic,
- to keep within the limits of endurance of the « dispatcher »,
- and above all, to make as economical an installation as possible consistent with giving the maximum output.

§ 7. — Where should the « dispatcher's » office be placed.

Taking into consideration the point of view of the traffic service of the trains, the situation for the « dispatcher's office » is immaterial, but the following reasons justify its installation in the offices of the local traffic manager :

1° The traffic manager whose principal business is the supervision of the running of the trains should be able to confer readily with the « dispatchers » regarding the best measures to be taken;

2° It is equally desirable that the « dispatchers » should be under the direct or-

ders of the traffic manager, so that, with respect to the running, they do not create a dual control with his own, or, as it is frequently expressed, a sort of *imperium in imperio*;

3° By examination of the actual graphical diagram showing the running of the trains, the traffic manager can at any instant obtain information on the working of his service;

4° The « dispatcher » acts with the authority that is a function of the traffic manager; the « dispatcher's » position in relation to the station-masters is consequently improved; actually he speaks « as acting for the manager »;

5° The central « dispatching offices » should be placed in the local traffic manager's offices in order that the « dispatchers » may be in direct contact with the office dealing with the distribution of wagons, which is also in the same building as the office of the traffic manager. This is desirable because the traffic service makes use of the telephonic apparatus of the « dispatching system » for the distribution of the rolling stock.

§ 8. — Future programme.

In view of the economies that have been effected, the Belgian State Railways have decided to extend the system over the whole of their lines and steps have been taken to carry out the following programme :

Brussels-Northern to Ostend line to be completed in July 1922.

Brussels-Northern to Herbesthal line of which the first section, Brussels-Ans, is to be completed by May 1922, and the other, Ans-Herbesthal, is to be completed by August 1922;

Namur-Arlon line, to be completed by October 1922.



Fig. 50. — Lines which will be worked on the "dispatching system" by 1 October 1922.

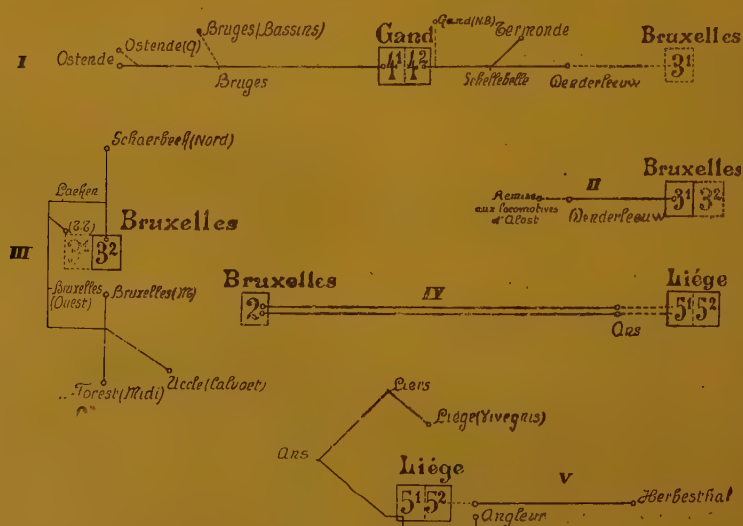


Fig. 51. — Diagrams I to V.

Explanation of French terms : Remise aux locomotives d'Alost = Alost locomotive sheds.

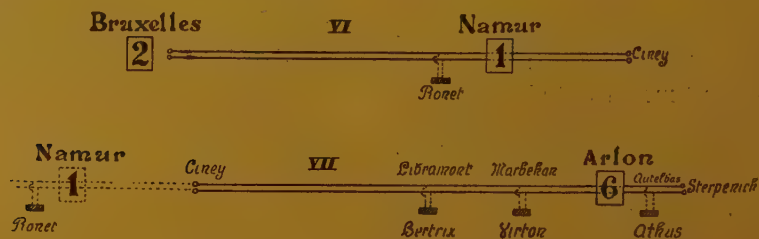


Fig. 52. — Diagrams VI and VII.

These lines are shown on the map (fig. 50); they are all double tracks and have a total length of 508 km. (315 miles):

215 km. (133 miles) are equipped with single circuit,

293 km. (182 miles) are equipped with double circuit.

All these lines will be fitted with selector telephone apparatus by the « Western Electric Company » with the exception of the Brussels-Ostend line which will be equipped, on trial, with apparatus of the type constructed by the « Société d'Electricité et de Mécanique (Thomson-Houston and Carels system) ».

The diagrams I to VII (figs. 51 and 52) show some details of the manner in which the circuits will be arranged and show particularly how the necessary liaison from cabin to cabin will be provided.

The leading idea, that consists in putting the « dispatchers » under the traffic managers for the reasons given above, has led to the formation of the sections that are given here.

1. — Brussels-Ostend line.

This line is divided into three sections:

1° *Ostend-Denderleeuw section*, diagram I, central office 4 at Ghent.

This is itself divided into two sub-sections: Ostend-Ghent (South) and Ghent (South)-Denderleeuw.

The sub-section Ostend-Ghent is served by the central office 4¹, and that of Ghent-Denderleeuw by the central office 4².

These two offices are installed in the same building and the liaison is effected by word of mouth between the two « dispatchers » 4¹ and 4² who are placed at the same table facing each other.

The Schellebelle-Termonde branch is also arranged for « dispatching » with a

view to rendering more easy the regulation of traffic at the Schellebelle junction.

2° *Denderleeuw-Brussels section*, diagram II, is served by the office 3¹ at Brussels.

A connection runs to the locomotive sheds at Alost.

In order to effect liaison between « dispatcher » 4² and « dispatcher » 3¹ the office 3¹ is connected as if it were a station cabin on the Ghent-Denderleeuw circuit, prolonged for this object to Brussels. Hence the « dispatcher » 4² at Ghent can call the « dispatcher » 3¹ at Brussels by turning the corresponding selector key. The « dispatcher » 3¹ can intervene when he wishes in the circuit of his colleague 4².

3° *Section relating to the railway round Brussels*, diagram III. — This is dependent on office 3² at Brussels, connected in liaison by word of mouth with cabin 3¹; the two « dispatchers » working these two offices being in this case also placed face to face at the same table.

2. — Brussels-Herbethal line.

This is divided into two sections: Brussels-Ans and Ans-Herbethal.

1° *Brussels-Ans section*, diagram IV, Brussels central office 2.

The two circuits are extended as far as the central office 5¹ at Liège, which is connected as if it were a station cabin on these circuits. The « dispatcher » 2 at Brussels can therefore call his colleague 5¹ at Liège when he desires and the latter can come on to the circuit of « dispatcher » 2 at will.

2° *Ans-Herbethal section*, diagram V, central office 5 at Liège.

This section itself comprises two sub-sections:

The sub-section Liège (Vivegnis)-Liers-

TABLE 5.

CENTRAL OFFICE.	SECTIONS SERVED.	Number of stations cabins with			Total.
		selector apparatus.	selector apparatus with switch to block cabin.	telephonic apparatus without selector.	
1	Brussels-Ciney (91 km.).	64	18	8	90
2	Brussels-Ans (94 km.).	79	20	6	105
{ 3 ¹	Brussels-Denderleeuw (24 km.).	22	1	4	27
{ 3 ²	Brussels ring-line (27 km.).	23	1	...	24
{ 4 ¹	Ostend-Ghent (70 km.).	27	8	3	38
{ 4 ²	Ghent-Denderleeuw-Termonde (47 km.).	44	5	...	49
{ 5 ¹	Liège (V.)-Liers-Ans-Angleur (4) (9 km.).	26	...	...	26
{ 5 ²	Angleur-Herbesthal (38 km.).	44	...	...	44
6	Ciney-Arlon (108 km.).	60	28	8	96
Total. . .	508 km. (2)	389	81	29	499

Ans-Liège (Guillemins)-Angleur, central office 5¹;

Sub-section Angleur-Herbesthal, central office 5²;

Liaison is established by word of mouth between the two « dispatchers » placed at the same table.

The single circuit Herbesthal-Angleur is, of course, extended as far as Liège.

3. — Brussels-Arlon line.

This line will be equipped with a double circuit if the results obtained from the trial on the Brussels-Ans line is satisfactory.

Here again there are two sections, *Brussels-Ciney* and *Ciney-Arlon*.

1° *Brussels-Ciney* section, diagram VI; this will be worked by cabin 1 installed at Namur. Actually the present Brussels office has charge of the first trial section from Brussels to Namur which will be transferred to Namur and will serve the old section prolonged as far as Ciney.

A connection is to be provided running to the station and locomotive shed of Ronet yard;

2° *Ciney-Arlon* section, diagram VII; this will be served by the central office 6 at Arlon. Connections are arranged extending to the stations of Sterpenich (frontier), Athus, Virton and Bertrix.

The liaison between the two sections will be effected by connecting central

(1) This sub-section comprises the heavy gradient from Liège to Ans, a continuous rise of 33 per mil.

(2) Connections not included.

office 1 on to the Arlon-Ciney circuit prolonged for the purpose. « Dispatcher » 6 at Arlon will be able to call his colleague 1 at Namur and the latter will be able at will to come on to the circuit of « dispatcher » 6.

Similarly the liaison of cabin 1 with cabin 2 will be effected by connecting this on to the Ciney-Brussels circuit.

Finally, to effect the liaison between sub-sections 3¹ and 3² on the one hand, and section 2 on the other hand, at the Brussels office an ordinary telephone will connect the tables of the « dispatchers ».

As will be seen, with the system of connections adopted the telephonic control of the trains running over the various lines worked by « dispatching » will be continuous.

Table 5 above shows the number of cabins in use on each section.

§ 9. — Conclusions.

The financial results shown above speak for themselves and require no comment.

It will not be over-estimating the value of the saving to be effected if the assumption be made that the 508 km. (316 miles) equipped, or to be equipped, with « dispatching » will effect the saving of 26 000 fr. per kilometre that has been obtained on the trial section. There is, therefore, an annual profit to be reckoned at 13 million fr. At the present time, when the Belgian State

Railways are tending more closely towards industrial working these results will certainly receive attention.

The regularity due to « dispatching » is valuable on account of all the benefits that it brings with it.

The satisfaction given to the public and to the railway staff is also a valuable asset.

Formerly the difficulties, which occurred periodically on the Belgian railway system at the commencement of the bad season, always found their origin on the Brussels-Arlon line and spread thence to the stations of Schaerbeek, Antwerp, Ronet and to the Liège line. It is to be noted that although the « dispatching » system has only been working as far as Namur there has been no case of disorganization recorded on the Luxembourg line during the course of last winter, whereas serious troubles have arisen on the Ghent and the Liège lines.

One is therefore tempted to conclude that the « dispatching system » makes its effects felt outside its own zone of action, and that it has an influence in removing those disturbances which, in the ordinary way, cause blocking of the traffic.

It may therefore be hoped that, in the early future, the introduction of the « dispatching » system on to the Brussels-Liège-Herbesthal, Brussels-Ostend and Brussels-Arlon lines will have the best of effects on the whole system. But — and this point should be insisted on — the « dispatching » will vary directly as the « dispatchers » and as the apparatus with which they are equipped.

Train indicator time-tables.

Figs. 1 to 5, pp. 1413 to 1417.

(*Railway Magazine.*)

For many years the need for a really informative train indicator for use at railway stations has been recognised, and many types have been introduced, some used to a considerable extent, others making a tentative appearance, and though they may have continued in use, have not been multiplied. A further need is to provide a means whereby passengers can be informed in a simple and clear manner as to the times of trains for particular destinations or routes, without need for tracing them out from time-tables, which for other than straightforward journeys, are necessarily somewhat confusing to many people, and may involve tracing a journey from one table to another. Indeed, railwaymen at country and intermediate stations are not always expert in regard to journeys beyond the limits of their own districts, and there is a considerable amount of truth in the suggestion conveyed by the following incident, overheard at a country station: The stationmaster's clerk, an obliging junior, had disappeared for some time. On his return the station-master asked where he had been. The clerk explained that he had been helping a passenger to trace out the train service on another line. To this his chief replied, impatiently: « Why did not you give the passenger the time-table and let him find out for himself? »

As a rule railwaymen are ready to give all the assistance they can, but frequently there is also the further diffi-

culty that between the public issues of time-tables and time-sheets for exhibition at stations there are incidental alterations and additions by public notice, so that the time-tables and time-sheets have to be considered in conjunction with supplementary notices, which may easily be overlooked by the unfamiliar traveller.

A type of indicator which approaches most nearly to the desideratum is that introduced by Messrs. Benn and Cronia, Limited, of 11, Borough High Street, London Bridge, S. E. 1. This owes its inception largely to the sympathetic support of chief officers of the London, Brighton & South Coast Railway, and the first indicators were installed at the railway station at Bexhill to meet the local competition by tramways. The original requirement was that the indicator should be readily adjustable to any alterations in the train services and should be easily visible at a reasonable distance. A further point was that it should give not merely the next train for a particular route or destination, but should cover the whole train service, corrected from day to day if need be, in a dissected form. On this basis the scheme of collecting the train times in classified groups was decided upon, built up in sections, wherein each train time is made up of separate elements — single numerals, letters, words, etc., as required — adapted for easy alteration individually and without affecting any other part.

A view is reproduced showing the first indicator — that erected at Bexhill in 1915 — and this illustrates the main features as adapted to meet the needs of a relatively small station involving only a few routes. This type of indicator

has, however, been adopted also at many of the large terminal and junction stations, in which case the sections are usually placed in two or more groups, separated by an artistic advertisement panel, or fitted round ticket or other



Fig. 1. — The first indicator erected at Bexhill, London, Brighton & South Coast Railway.

windows, or even doorways, so that where a large amount of information has to be given the sections are separated to avoid any sense of confusion and to cause passengers consulting the indicators to distribute themselves sufficiently to obviate crowding.

The special constructional features of these indicators are covered by letters patent. Briefly, a number of frames of suitable dimensions are combined within a main frame, each section being separately removable on releasing a lock, and containing a series of grooves in

which enamelled plates carrying words, numerals or letters with blanks of varying sizes, are placed as required, the ends of the grooves being closed by hinged side pieces, so that numerals, letters or words in each line can be individually altered as need arises. Each main frame includes as many smaller frames as desired, and is shaped and dimensioned to suit the position selected for erection, usually along the wall of a booking office, on the station wall, either outside or inside, but necessarily protected from rain (for the benefit of passengers referring to it), or an indicator standing in the circulating area of a station.

Under a main heading bearing the name of the station and the words « Trains leave this station », is a sub-heading, « Weekdays », and below that a series of sectional frames, each individually removable. These are headed by the names of stations served by the trains detailed below, or a general description of the service; next comes the platform number or letter if required to be set forth, and below that again the times of all trains on the service concerned. These times are built up of separate numerals (in black), grouped with letters or signs (in red) referring to footnote explanations below as required, with spacing pieces. Usually the frames are designed for the full summer service of trains, blanks being substituted in spaces which are not required as the train service is reduced, so as to be available for use again in due course. In each separate groove, however, individual plates can be taken out for alteration as required without affecting any other line, as permitted by the hinged side pieces of the frame.

Frequently, if the trains are not very numerous, a single sectional frame will contain two or three headings and groups of train times below; but each sectional frame is kept to moderate dimensions so that it can be easily mani-

pulated. Below the weekday frames are others for the Sunday services, which are usually kept quite distinct, and at the base various footnote references, such as S = « Saturdays only », E = « Saturdays excepted », P = « Pullman car », etc., are set forth.

In construction the indicator includes only a main frame, into which the sectional frames, whose sides are hinged to enable the numeral, letter or blank plates readily to be taken out for alteration, are secured by locks or other fastenings. For keeping a supply of spare plates provision is made behind the footnote section by dividing the back of the indicator into a sufficient number of pigeon holes to carry a spare quantity of each numeral, stocked in numerical order. The whole of the exposed framework is usually constructed in Indian teak, thus rendering it practically fire and waterproof.

During the war the Benn & Cronin indicators showed their value in a marked degree. Public time-sheets could not be obtained from the printers by the dates altered schedules came into force, while public time-tables were not issued. Yet, on the basis of staff time-tables and information sent down from headquarters, these indicators could as readily be corrected, as the day for alteration came round, as under usual conditions, with the result that at many big stations on the Brighton Railway system there were, on the first of the month, and especially when big reductions or alterations were expected, as on 1 January 1917, « indicator queues » of people noting the train services which concerned them. Such conditions no longer apply, of course, but the value of the indicator is the same — on the day a new time-table comes into force the necessary alterations can be quickly made by the stationmaster and a leaning member of his staff, or by others who may be deputed for the task, and, in addition, the alterations otherwise included only in « train alteration »

slips or posters can be made at any time, whether new time-sheets and time-tables are issued or not. Incidentally, while on alteration dates a certain amount of work is given to responsible members of the station staff, this is much more than compensated for by the almost complete elimination of inquiries from the travelling public.

The great feature of the indicator is that any line can be altered in a few minutes, each section being separately removable, and the time-table can thus be kept absolutely up-to-date. Indeed, on the day before a train alteration comes into effect, on a Saturday preceding a Monday or on a Sunday preceding the one concerned the change can be made as soon as the train affected has gone for that day, and not infrequently this is done for all morning trains during the afternoon of the last day on which they run as previously shown. In fact, in large measure, these indicators render time-tables and time-sheets unnecessary for ordinary reference purposes. As the train times are collected for each destination or route the time-table is, in effect, dissected according to all requirements which can reasonably be anticipated and provided for. This appeals especially to women passengers, to many of whom an ordinary time-sheet or time-table is a source of bewilderment, and it is a convenience to everyone. It has been suggested that the « next » trains should be specially identified, but an important feature of the Benn & Cronin indicator is that it shows the complete service, already dissected from others with which the « referee » is not concerned. It is, therefore, often consulted by arriving passengers with a view to noting the times of return trains later in the day.

The actual design and arrangement varies, of course, according to each location. Thus, at smaller stations, there may be only a single composite panel, but usually at least two are used, com-

bined with an artistic advertisement, as already mentioned, to form, with a suitable head-board (which may include a clock face, the name of the station and railway, etc.), an ornament as well as an adjunct to the booking hall or circulating area of a station. Colour is introduced by the advertisement panel and sometimes by the heading, but all timetable information is on white enamelled iron, bearing black or red numerals, letters, etc. Other colours can, of course, be utilised, if desired, but, as a rule, it is found that red or black is quite sufficient. In fact, as multiplication of colours adds seriously to the stock of numerals, letters, etc., required for each indicator, it is found to be best to show all train times in black numerals on a white ground; reference letters, platform numbers, conventional signs to denote express, Pullman or restaurant car trains being in red on white. The weekday and Sunday services are, of course, shown separately. Explanations of references used may be placed below the panels to which they apply, but they are sometimes placed in other convenient positions. Sections may also be devoted to excursion train arrangements, and occasionally special notices are inserted in spaces not immediately required. It is, of course, possible to show the platforms from which trains depart or at which they are scheduled to arrive. In regard to the latter, in some of the more recently installed indicators an arrangement is adopted whereby the plates showing the platform number can be changed without requiring the whole section concerned to be removed. This provides for cases where a train which ordinarily uses a particular platform has on any particular day to be altered to another, and for changes at short notice.

In addition to their standard use, these indicators can also be adapted for associated purposes. For instance, as shown in one of the illustrations, at the Talbot Road and Central stations at



Fig. 2. — Benn & Cronin train indicator at Hastings. — London, Brighton & South Coast and South Eastern and Chatham Railway train service panels fitted around the respective ticket windows.



Fig. 3. — Benn & Cronin train indicator at Cambridge. — Showing Great Eastern Railway and other train services. Panels arranged around and between entrance gates.



Fig. 4. — Benn & Cronin "all weather" excursion train indicator erected at Blackpool (Central) Station.



Fig. 5. — Benn & Cronin "all weather" indicator adapted for excursion train announcements at Blackpool (Talbot Road) Station.

Blackpool, London & North Western Railway, a Benn & Cronin indicator, adapted to the requirements of heavy excursion traffic, has just been installed. These have been introduced for the excursion platforms of each station, and, instead of showing train services, give particulars of the numerous return excursion trains required every day throughout the summer months and at holiday times for Blackpool traffic. These indicators are necessarily on a large scale and are constructed on the same lines as the time-table indicators. They show, however, the official train numbers, names of principal destination stations, time of departure and platform number, prepared according to the requirements of each day. Under the headings of train number, time of departure and number of platform, the panels are of the new swing type mentioned above, to cover alterations at short notice, and, as a rule, it is sufficient to alter these without unlocking the large panels, it being necessary only to release the swing hinge at the top edge of the number plates. About eighty trains can be shown on each indicator. These indicators are of an « all-weather » type, and are provided with sliding glass doors, formed in three sections, running on rollers, the centre door sliding in front of those on either side, so that the glazed section covering any one of the three sections can readily be moved sideways to allow access to the portion which it normally covers and protects. Glazed covers of this type are also used for the ordinary time-table indicators where they may need to be placed in the open, especially where they have to be installed on other than railway premises. For example, where a railway station is some distance from the centre of a town, an indicator is erected in the market place or other prominent position, so that prospective passengers can obtain railway information without having to go to the station or

hunt up a printed time-table. Such indicators, when installed on other than railway premises, have the further advantage that they are exhibited as a rule at centres of tramway and road traffic, and their presence will frequently bring to mind that the railway provides facilities for travelling to places also served by road.

As showing the wide applicability of the Benn & Cronin type of indicator, two views are reproduced showing interesting examples of their application to meet particular requirements. One shows an indicator installed at Hastings. In this case the train panels are placed adjacent to the ticket windows used respectively by the London, Brighton & South Coast and South Eastern & Chatham Railways, with excursion panels over the respective ticket windows. Another view shows an indicator at Cambridge station, Great Eastern Railway. In this case the indicator is fitted around and between the gateways controlling access to the platforms, explanatory notes and excursion announcements appearing over the centre gateway. The indications applying to Great Northern, Midland, London & North Western and Great Northern and Great Eastern Joint Line services, together with times of Continental traffic trains, are placed below the advertising section. At Guildford station, London & South Western Railway, three time-table panels and one advertising panel are fitted round a somewhat awkward corner in the booking hall. At many stations two or more of these indicators are required in the various booking offices or at each entrance, if there is more than one. The indicators at each position need not be exact duplicates. Frequently it is found better to place the panels most in request at one part of the station in the more prominent positions, and in some instances it may be sufficient to give only partial particulars. Thus, at Cam-

OBITUARY

CARLO CROVA,

Engineer,

General manager of the Italian State Railways;

President of the Italian Organisation Committee and President of the session of the International Railway Congress Association held at Rome in 1922;

Life member of the Permanent Commission of that Association.



On 23 July 1922 there died at Rome, after a long illness, Mr. Carlo Crova, general manager of the Italian State Railways.

As president of the Italian Organization Committee for the Congress held at Rome in 1922, he had prepared with special care and unwearying energy those details which made this Congress stand out amongst our meetings not only be-

cause of the technical results, but also because of the cordiality of the welcome offered us and the excellent arrangements made for our reception.

The Congress nominated him as president for the session. Unfortunately he was already visibly suffering from the painful illness to which he has succumbed; by an unbelievable force of will power, which we shall always associate with the respect we feel for his memory, he took part in the work of the Congress and delivered in an impressive tone the speeches which we received with enthusiasm and which were, unfortunately, the last work of his incredible energy.

Engineer Carlo Crova was born at Asti in Piedmont in 1862. After obtaining his diploma in engineering in 1886, he chose a railway career and was appointed a cadet inspector on the Meridionali Railway, which afterwards became the Adriatic Company. From the commencement of his career his special qualities were appreciated. The first nine years of his service were passed in the working side of the Operation and Traffic Departments in the most important offices. He was then moved to the Central Transport Office at Bologna, where he remained for ten years.

In 1905, when the railways were taken over by the Italian Government, he became chief of the secretariat de la Direction

for the Milan division, and after a year at this post, was appointed chief of Operation and Traffic for the Rome division. In 1909 he took up the position of assistant chief officer in charge of the working side of Operation and Traffic, becoming successively head of this section and head of the department.

In September 1920 he was made general manager of the Italian State Railways.

He rendered to his administration very important service, particularly during the difficult conditions whilst the world wide war lasted.

He was a man of exemplary character, an indefatigable worker, and never spared himself in carrying out his duties; he was devoted to his work until the very last moment of his life.

During the war he was amongst the most energetic and enthusiastic workers in the great effort the railways made to ensure the victory of their country.

When the war was over he applied himself with tireless energy to the work of restoring normal conditions without unfortunately living to see the result of his work.

After the meeting in Rome he was made a life member of our Permanent Commission in recognition of the very valuable services he had rendered. He was unfortunately to enjoy this great honour for so short a time.

Our Association will preserve a most touching memory of him, and offer to his sorrowing family their sincere sympathy.

The Executive Committee.

NEW BOOKS AND PUBLICATIONS

[388. (08 (.45) & 388. (04]

ITALIAN STATE RAILWAYS. — *Relazione per l'anno finanziario 1919-20* (Report on the working of the Italian State Railways 1919-20). — 1 volume large 8^{vo} (12 1/2 × 9 inches) of xv + 207 pages. — 1921, Rome, Polygraphic Department of the War Office, via Gino Capponi, 43-45.

The Administration of the Italian State Railways has recently published its report for the financial year 1919-20. This is a very important document from an historical point of view, giving as it does the consequences of the war and the economic troubles which have followed it.

This report enables the reader to make a rapid review of the effects of the war, and draws a very close comparison between the results obtained in 1919-20

and those of the preceding financial year, and with those of the last *pre-war* financial year, that is to say, 1913-14.

The lines operated by the State have been extended by 18.94 % over pre-war figures, these being, at the end of June 1920, 15 720 km. (9 768 miles) of standard gauge track and 806 km. (501 miles) of narrow gauge, as against 13 666 and 228 (8 492 and 142) respectively in 1914.

The financial results are summarised in the following table :

	1913-14	1918-19	1919-20
	Lire.		
Receipts	614 648 254	1 767 251 734	1 996 255 288
Expenditure	586 580 192	1 767 194 017	2 856 006 785
Difference { credit. — Profit	+ 28 068 062	+ 57 717	...
debit. — Deficit	...	...	— 859 751 497
Difference as compared with 1913-14	...	— 28 010 345	— 887 819 559
Coefficient of operation	81.25	94.44	137.49

The preceding years were productive of small profits, with the exception of 1914-15, which resulted in a deficit of about 21 million lire. In 1919-20 the working costs increased considerably and there was for the first time a serious

deficit (859 751 497 lire), whilst the coefficient of operation was well above 100 %, ranging from 81.25 to 137.49 %.

In order to ascertain the reasons for these results, it is necessary to analyse

the variations in the receipts under their different headings, and deal similarly with the working expenses.

The results are as follows, compared in each case with the financial years 1913-14 and 1918-19 :

	1913-14	1918-19	1919-20
	Lire.	Lire.	Lire.
Traffic receipts	577 831 156	1 593 089 770	1 804 936 199
Receipts other than traffic	32 753 762	157 947 512	172 879 068
Various.	4 063 336	16 214 452	18 440 021
Totals.	614 648 254	1 767 251 734	1 996 255 288

The remarkable increase in the traffic receipts which was experienced during the war was mainly due to the military traffic, and only to a small extent to the increase in rates brought into force since 1916-17. The later increase, on the other hand, has been chiefly caused by

the increase in rates, because the variation in the bulk of the total traffic has been negligible, that is to say, after the war the commercial traffic has gradually replaced the military traffic, as is shown in the following table :

	1913-14	1914-15	1915-16	1916-17	1917-18	1918-19	1919-20
	Million lire.						
Total traffic receipts	577.8	574.3	761.1	1 080.5	1 257.2	1 593.1	1 804.9
Total commercial traffic receipts	572.7	526.7	538.7	595.8	605.7	779.3	1 565.4
Total military traffic receipts	5.1	47.6	222.4	484.7	651.5	813.8	239.5
Military traffic as a ratio of total traffic receipts	0.0088	0.083	0.292	0.449	0.518	0.511	0.133

These figures, however, do not fully illustrate the work that has been accomplished, which can be better determined from the receipts per kilometre, per

train-kilometre and axle-kilometre, especially if we deduct the increase in rates from the figures for the year 1919-20 :

	1913-14	1919-20
	Lire.	Lire
Receipts per kilometre	41 877.86	68 368.06
— per train-kilometre	4.84	10.93
— per axle-kilometre.	0.151	0.284

* * *

We will now deal with the variation in working expenses, under the different headings, in the same way as we have done for the receipts. We will follow

the original publication of the Italian Administration in making this analysis, but will confine ourselves to dealing with lines for which complete particulars are available of the results obtained.

—	1913-14	1918-19	1919-20
	Lire.	Lire.	Lire.
Ordinary expenses	469 976 815	1 581 632 116	2 631 732 960
Supplementary expenses	27 780 000	64 648 324	72 682 150
Sundry expenses.	88 823 377	120 913 577	151 591 675
Totals.	586 580 192	1 767 194 017	2 856 006 785

It will be seen that the increases are very great, but before explaining these in detail, it may be well to summarise in a table the expenses which are

beyond the control of the Administration, or are dependent on matters which it has to deal with outside the scope of its ordinary business.

—	1913-14	1918-19	1919-20
	Million lire.	Million lire.	Million lire.
1. Increase in the cost of fuel for locomotive purposes compared with that for 1913-14.	...	431.712	888.275
2. Increase in cost of other materials compared with 1913-14.	...	45.000	50.000
3. Concessions to the staff (wages and conditions of employment)	25.550	271.000	540.000
4. Expenses due to staff with the army	...	16.460	2.842
5. Cost of living bonus	...	151.000	185.000
6. Effects of rate of exchange	+ 0.168	— 2.847	— 12.253
7. Interest and paying off capital	79.001	101.417	101.853
8. Deficit of the light railways of Sicily and Sardinia	0.564	3.815	7.652
9. Deficit due to steam packet services to the islands and to the Palermo-Corleone line.	1.440	3.379	15.065
10. Other headings, including the reductions in ordinary rates	2.743	17.489	30.787
Totals.	109.466	1 042.425	1 809.173
Total increase compared with 1913-14	...	939.959	1 699.755

As a whole, these expenses have increased from 18 % to 64 % of the ordinary expenses, but the most serious items are the cost of fuel and the wages bill, and of these the former has a special importance in the case of the Italian railways.

As a matter of fact the total cost of fuel, which was 76.055 million lire in 1913-14, increased to 526.413 million in 1918-19 and to 997.993 million in 1919-20; the average price per ton, which before the war was 36.46 lire and which gradually advanced to 202.67 lire in 1918-19, rose still further to 397.84 lire

in 1919-20 in consequence of the ever increasing cost of production, of rates of exchange, and of freight.

The wages bill of the staff engaged in working the railways amounted to 1 270.761 million lire in 1919-20, as against 283.643 million in 1913-14, and 796.845 million in 1918-19.

The latter increase is due to the introduction of new rates of pay, to the eight hour day, to the rest hours allowed, and to the extension of the railway system. The average wage during the war was increased to 4 631 lire per year as against 1 918 lire. In 1919-20 it increased still

further to 6 498 lire. The number of employees had reached 216 075 in place of 147 387 in 1913-14. The eight hour day has in itself necessitated an increase of nearly 25 000 employees.

A third element which has an important bearing on the results obtained, is

the cost of repairs and price of materials. In 1913-14 the cost of repairing a locomotive in private shops was 23 858 lire. The average cost became 47 679 lire in 1918-19 and 85 085 lire in 1919-20. The average cost of repairing vehicles, also in private shops, has been as follows :

	1913-14	1918-19	1919-20
	Lire.	Lire.	Lire.
Per axle of a coach	898	2 008	3 793
— of a brake-van	448	2 349	2 352
— of a wagon	299	1 002	1 342

As regards the materials which are most commonly used for railway work, the following table shows at a glance

that the cost in 1919-20 was at least five times as great as in 1913-14 :

MATERIAL.	Average price in		Increase per cent.
	1913-14	1919-20	
	Lire.	Lire.	
Bar iron	25	142	570
Iron plates	32.5	256	785
Bar copper	227	963	425
Bar brass	181	601	332
Tin	450	1 970	436
Zinc	72	304	425
Lead	54	232	429

The financial year 1919-20 has been marked by a determined effort on the part of the railway system to put its equipment, both permanent way and rolling stock, in a fit state to cope with the traffic requirements, in spite of the difficulties and high prices of the post-war period.

It has been necessary to resume the construction of new lines; to improve and put the system into good order by repairing the damage done by the enemy in the region which suffered most severely during the military operations; and to carry out the repairs which were postponed during the war.

The difficulties and the high cost of fuel have led railway administrations,

in almost all countries, to prepare important electrification schemes, the carrying out of which will extend over some years. This same situation exists in Italy, in which the fuel problem is more acute than in other countries.

In 1919 it was decided to electrify 6 000 km. (3 728 miles) of line, but subsequently it was more definitely laid down which lines were to be first dealt with, in view of the large amount of power required, on account of gradients and density of traffic, or these two factors combined.

Dealing with the subject of electric traction in Italy, we do not consider that it is necessary to enter into details, but will merely refer to the report

submitted to the recent International Railway Congress at Rome by Mr. Donati ⁽¹⁾. It may, however, be added that the Italian authorities have also proceeded with the plans and construction of great hydro-electric power stations at Bardonecchia, Reno, two at Limentre in the neighbourhood of Bologna, at Calore to supply power for

electrification of the lines around Naples, and at Sagittario, which is intended to supply power for the line from Rome to the Adriatic.

The situation as regards the rolling stock is given in the following table, which also shows the number of vehicles per kilometre of line in operation :

—	Total number at the end of June.						Increase or decrease at end of June compared with same date in undermentioned years.			
	1920		1919		1914		1919		1914	
	Total number.	Per km. of line open.	Total number.	Per km. of line open.	Total number.	Per km. of line open.	Total number.	Per km. of line open.	Total number.	Per km. of line open.
Steam locomotives and rail auto-cars. . .	6 267	0.415	5 847	0.400	5 124	0.386	+ 420	+ 0.014	+ 1 143	+ 0.028
Electric locomotives and rail auto-cars . .	264		251		152		+ 13		+ 112	
Passenger coaches . .	10 941	0.695	10 131	0.664	9 931	0.726	+ 810	+ 0.030	+ 1 010	— 0.032
Brake-vans	4 480	0.285	4 432	0.290	3 788	0.277	+ 48	— 0.006	+ 692	+ 0.007
Wagons	145 090	9.230	130 730	8.578	103 072	7.534	+ 14 360	+ 0.633	+ 42 018	+ 1.677

The whole of these numbers were not however available for traffic. There has been a remarkable increase in the amount of rolling stock *unfit for traffic and waiting repairs*, and this arises either

from labour troubles, both in private works and in the railway workshops, or from the condition of the rolling stock itself :

—	Locomotives and rail auto-cars.		Passenger coaches.		Brake-vans.		Wagons.	
	Number to be repaired.	Percentage of total number.	Number to be repaired.	Percentage of total number.	Number to be repaired.	Percentage of total number.	Number to be repaired.	Percentage of total number.
1919-20.	1 708	27.6	4 285	39.6	1 660	34.7	23 735	16.2
1918-19.	1 216	22.4	3 677	35.3	1 218	30.0	12 937	10.6
1913-14.	836	16.6	2 615	24.7	962	27.3	10 438	10.0

As regards new locomotive stock, 390 steam and 55 electric locomotives

were ordered during the war, and 486 and 78 respectively in 1919-20. Of the vehicles already ordered, 69 coaches and 22 214 wagons have yet to be delivered, and to these must be added those ordered in 1919-20, that is to say, 652

⁽¹⁾ See the *Bulletin of the International Railway Association* for December 1921 (English edition), p. 2175.

coaches, 251 brake vans and 3 204 wagons.

* * *

From a traffic standpoint, the year 1919-20 is characterised by almost entire cessation of military traffic and its replacement by commercial transport. The quantities handled were 3 788 135

wagon loads (goods and cattle) and 39 727 332 t. (goods), as against 3 707 412 wagon loads (— 2.13 %) and 38 994 129 t. (— 1.85 %) in the preceding year, and 5 026 295 wagon loads (+ 32.68 %) and 41 421 872 t. (+ 4.27 %) in 1913-14.

The number of wagons loaded with goods and cattle per working day is as follows :

—	1919-20	1918-19	1913-14
	Wagons.	Wagons.	Wagons.
In July.	11 421	12 516	14 518
In August.	11 444	12 820	15 138
In September.	11 825	12 387	15 717
In October.	12 151	10 860	16 303
In November.	11 427	9 944	14 939
In December.	10 930	8 597	14 191
In January.	8 273 (strike)	9 551	12 956
In February.	11 393	10 291	13 871
In March.	12 064	11 084	14 763
In April.	11 586	11 397	14 810
In May.	12 505	12 081	14 103
In June.	11 509	12 277	13 727
Average. . .	11 378	11 151	14 586

The total number of freight train-kilometres was 49 330 008, against 50 678 142 in 1918-19 and 45 016 049 in 1913-14. The distance run by wagons fell to 2 421 018 179 axle-kilometres, from 2 852 277 188 in 1918-19 and 2 190 162 487 in 1913-14.

The freight ton-kilometres, which was 7 069 885 000 in 1913-14, and which

reached 11 083 475 000 during the war, fell in 1919-20 to 9 795 568 000. For the last financial year the ton-kilometres per kilometre of line open increased by 23.01 %.

As is the case with railways in general, there has been a serious increase in the amount paid in compensation for losses, delays and damages :

—	In 1919-20	Increase compared with	
		1918-19	1913-14
	Million lire.	Million lire.	Million lire.
Damage	5.9	3.0	4.2
Losses	26.4	17.3	24.9
Delays	0.2	0.1	0.2
Other causes	0.7	0.1	0.08
Totals. . .	33.2	20.5	29.38

This increase is partly due to the extent of compensation, to the rise in the prices of all commodities, to embezzlements and thefts, which tend to become

more prevalent under the existing general working conditions.

Engineer N. GIOVENE,
Italian State Railways.

[385.15 (.54) & 385. (04)]

INDIAN RAILWAY COMMITTEE, 1920-21. — Report of the committee appointed by the Secretary of State for India to enquire into the administration and working of Indian Railways. — 4 volumes 4^{to} (14 × 8 1/4 inches) of 106, 266, III + 330 and III + 350 pages. — 1921, London, His Majesty's Stationery Office, Imperial House, Kingsway, London, W. C. 2. — Price, bound : 1st vol., 1 sh. 6 d. net; 2nd vol., 3 sh. net; 3rd vol., 4 sh. net; 4th vol., 4 sh. net.

The committee of which Sir William M. Acworth was the chairman was appointed in consequence of questions which arose regarding the steps to be taken at the expiry of the contract for working the East Indian Railway. This railway, which is State property, is worked by the East Indian Railway Company, and the agreement made with the Secretary of State for India, which terminated in 1919, has been, as a temporary measure, extended to 1924.

The terms of reference which the committee had to report upon were :

To examine, for the special case of railways owned by the State, the respective advantages of the alternative methods of working (by the State or by companies); to examine the system of control exercised by the Government of India over the railway administration; to state whether the control over rates and the means adopted to settle disputes between the railways and the traders are satisfactory, and if not, to suggest what measures should be taken; to investigate ways and means of financing the Indian Railways, and especially the possibility of making better use of private capital for the construction of new lines; to make any other propositions of a similar nature.

It will be seen that the committee had to touch upon every aspect of the problem of the organisation of Indian Railways.

The Committee, consisting in the first place of members who happened to be in England at the time of its formation, commenced its enquiry by collecting information from the officials of the Indian Office and from the London re-

presentatives of the guaranteed companies. It then proceeded to India where evidence was taken from 142 witnesses comprising railway employees and officials, and Indian and European private individuals. This evidence and various statements form the contents of two volumes of 266 and 330 pages, these constituting appendices to the report proper. A third appendix of 350 pages contains the written statements of individuals consulted by the committee.

The report proper forms a book of 106 pages. It is a very interesting publication, not only on account of the information which it gives as regards the Indian Railways, but also from the proposals which it contains as regards the question of organisation, and which, having a general bearing, are applicable to many other railways.

After the first chapter, which is introductory and deals with the formation of the committee, its terms of reference and the enquiry which it conducted, chapter II gives an examination of the present day situation on the Indian Railways. Chapter III deals with the financial question and the control of finances by the Government. Chapter IV is directed to the discussion of the powers of the administrative authorities on which the railways are dependent. Chapter V deals with the relations between the railways and its customers. Various matters which have a bearing on the general problem are dealt with in chapter VI, relating in particular to the branch lines, to the gauge question, and to the employment of Indians in the higher grades and their technical education. In chapter VII the question of the

operation of the lines by the State or by companies is discussed, as are also the methods to be adopted to raise the necessary capital. Chapter VIII gives a resume of the whole subject and also the proposals which are recommended.

India has a population of 300 million inhabitants, and an area of 1 800 000 square miles. There are 36 700 miles of railway of which about two thirds belong to the State (being worked by the State or by guaranteed companies). The present day situation is marked by an inadequacy in the means of transport and lines of communication, which hampers the development of coal mining, prevents the extension of the metal industry, and is a serious obstacle to commercial development. As regards the passenger services, complaint is especially made of the bad travelling conditions for third class passengers, and of the lack of rolling stock which leads to overcrowding and renders a journey particularly uncomfortable and inconvenient.

This inability on the part of the railways to satisfy the needs of the population, and the requirements of commerce and industry is attributed, among other causes, to the lack of capital for constructing new lines or for increasing the rolling stock and accommodation. The report emphasises very clearly in chapter III the disadvantages arising from a system which consists of merging the finances of the railways in the general finances of the State, such as, works commenced and not being able to be finished on account of sufficient capital being available; capital granted during periods when it is difficult to make rational use of it, or capital which is often insufficient and reduced without due consideration. Thus, the committee is unanimous in recommending that the railways should have a separate balance sheet and be run as a commercial enterprise. Under this system the balance sheet would be submitted to the legislative assembly, not by the Minister of

Finance, but by a Minister having authority over the railways, and the railways would control their own receipts and expenses, but being obliged to pay interest on the capital borrowed by the Government for their construction.

Although the committee was unanimous on the above point, this is not the case with regard to the question of whether the lines should be worked directly by the State or by private companies. The reasons given by the president and four other members, for recommending State working, and on the other hand, by the five other members, for recommending the formation of Indian companies, give chapter VII a special interest.

One cannot attempt in a brief review to give a complete resume of a treatise which deals so fully with the questions concerned. One must mention, however, that there are some interesting remarks in chapter IV dealing with the organisation of the administration, the powers of the higher officials, and their relations with the staff and with the legislative and executive authorities.

In order to investigate complaints as to the making and arbitrary application of rates, as mentioned in chapter V, the committee proposes to set up a Rates Tribunal similar to that instituted in England by the Act of 1921. Bound up with the question of rates is that of compensation. The enquiry has revealed that many claims arising out of delays, damage or loss have not been dealt with in a satisfactory manner, or that in some cases no action has been taken. The Committee proposes, in order to put a stop to this state of affairs, that the Ministry shall call for frequent reports showing the number of these claims and the length of time that these have been outstanding.

Among other questions dealt with in chapter VI, we have mentioned that of gauge. In India there are four gauges in use; the « Standard » Indian gauge, which is 5 ft. 6 in. is only in use over 17 990 miles of track out of a total of

36 735 miles. The other gauges are the metre gauge (3 ft. 3 3/8 in.) of which there is 15 000 miles, the 2 ft. 6 in. gauge used over 3 000 miles, and the 2 foot gauge used over 600 miles.

The committee proposes that this special question, which it considers as being of the greatest importance to India, be submitted to a committee of experts. One of the members, however, while regretting that so large a gauge as the 5 ft. 6 in. had been adopted at the outset (of which moreover the full advantage as regards the dimensions of rolling stock has not been taken) pointed out that with the available resources, it would have been impossible, if this

gauge had been rigidly adhered to, to have reached even the rather restricted development which exists today. Moreover, the difficulties of transshipping goods are not as great as are sometimes supposed, and the capital which may be available in the future should be used in extending the lines and their facilities, which is a pressing necessity rather than in changing the gauge of the existing lines.

This report with its appendices will be read with great interest by all concerned in railway organisation, and in the financial and commercial problems which arise out of it.

E. M.
